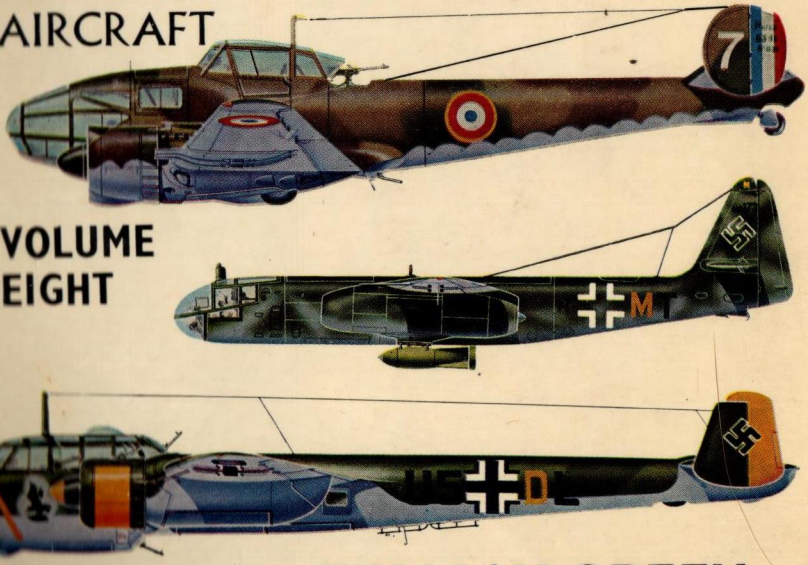
WAR PLANES OF THE SECOND WORLD WAR

BOMBERS

AND RECONNAISSANCE AIRCRAFT



VOLUME EIGHT

WILLIAM GREEN

BOMBERS AND RECCE ACFT. VOL. 8

DOUBLEDAY

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WAR PLANES OF THE SECOND WORLD WAR

by

William Green

Volume VIII

BOMBERS AND RECONNAISSANCE AIRCRAFT

Volume Eight is the second in a series of volumes to be devoted to land-based aircraft employed during the Second World War for bombing, reconnaissance or army co-operation, irrespective of age or importance, as well as those aircraft that were being actively developed for such tasks by the various combatants during 1939–1945.

Cover illustrations (top to bottom): Potez 63.11 No. 831 (North Africa, 1943), an Arado Ar 234B–2/p Blitz of 9.KG 76 (Achmer, February 1945), and Dornier Do 17Z–2 of 3./KG 2 (Tatoi Greece, May 1941).

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WILLIAM GREEN

With Drawings by Dennis I. Punnett

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INTRODUCTION

In the Introduction to the preceding volume of *War Planes of the Second World War*, I referred to the unprecedented acceleration in the process of change in combat aircraft design that took place in the three years immediately preceding the Second World War. This metamorphosis, encouraged by gathering war clouds, was as nothing, however, if compared with that engendered by the conflict itself, and this second volume in the series devoted to the bomber and reconnaissance aircraft of the combatants reflects the radical character of the transformation in these categories of warplane more effectively than the earlier volume.

Completing the coverage of France's bombers and reconnaissance aircraft and commencing that of German aircraft designed for similar functions, this volume is, for the most part, devoted primarily to war planes that were already mature when hostilities began, or achieved maturity during the opening phase of the conflict, and were thus among the first to see action. It also illustrates and describes,however, two aircraft that carried bomber and reconnaissance aircraft development to the ultimate insofar as the Second World War was concerned, the Arado Ar 234B Blitz and the DFS 228. A comparison of these with the other aircraft that share the pages of this volume reveals fully the dramatic nature of the changes that took place under the impetus of war.

There was, of course, little radical about the Ar 234B other than its power plants, but these completely revolutionized the bomber as they did virtually every other category of combat aircraft. The turbojet was at an early stage of development but its effect was clearly demonstrated by the Ar 234B, the first bomber to utilize this form of power plant, and it is of interest to draw a comparison between this and the Dornier Do 17Z with which the *Luftwaffe* entered the war. A four-seat medium bomber, the Do 17Z attained a maximum speed of 224 m.p.h. at 13,120 ft. with its maximum offensive load of 2,205 lb., whereas, five years later, the Ar 234B single-seat *light* reconnaissance-bomber was carrying a 3,300-lb. bomb load at almost twice the speed and altitude. Insofar as the DFS 228 was concerned, so radical was the concept of this rocket-boosted glider that there was nothing with which it could be readily compared, but an extension of its basic concept was to be seen some 10 years later when the Lockheed U-2 made its début.

Differing markedly in appearance and performance though the aircraft described and illustrated on the following pages undoubtedly did, they were, with but two exceptions, designed to carry bombs or cameras or both. The exceptions are two commercial transports adapted for more militant roles as a result of the exigencies of the times, one of these, the Centre NC 223.4, actually gaining a measure of immortality as the first Allied *bomber* to attack Berlin!

The term "bomber" covered an enormous number of aircraft varying widely in size and capability; aircraft ranging from the single-seat Loire-Nieuport 40, which, even before the debacle of the notorious Junkers Ju 87 during the "Battle of Britain", proved the dive bomber to be the natural prey of the fighter and incapable of surviving without virtually total

air superiority, to the four-engined so-called "heavies" which, stemming from the drawing boards of the old Farman company, provided the backbone of the *Armée de l'Air's* nocturnal strategic force when hostilities began. Between these opposite ends of the size and weight scale, this volume details such aircraft in the "medium" category as the aesthetically superb LeO 45 and the previously-mentioned Dornier Do 17 which, when first revealed in the mid 'thirties, conformed with a theory of air strategy in which the fighter was relegated to a secondary role.

The pattern established by previous volumes of *War Planes of the Second World War* is followed in the subsequent pages in that every effort has been made to record *all* aircraft in the bomber and reconnaissance categories that were actually under active development or construction during the war years, or saw active service, irrespective of their age, and, where applicable, a synopsis of their operational careers. The coverage of German bombers and reconnaissance aircraft continues in volume nine, which commences with the Dornier Do 215, and is completed in volume ten.

As with previous volumes, I feel justified in claiming that much hitherto unpublished information appears on the pages that follow, and that a number of errors of fact published in the past have now been corrected. Once again I should like to record my gratitude to Pierre Leyvastre for his invaluable assistance in researching the development and operational histories of the French aircraft appearing in this volume; to my fondly-remembered friend of many years, the late Gert W. Heumann, who checked my typescript for the German aircraft types and whose untimely death was an immeasurable loss to the ranks of aviation historians, and to Dennis Punnett for his line drawings which continue to set new high standards in accuracy. I should also like to record my thanks to the historical sections of France's *Armée de l'Air* and *Marine Nationale*, and the personnel of the Nord-Aviation, Sud-Aviation, Breguet and Latécoère concerns.

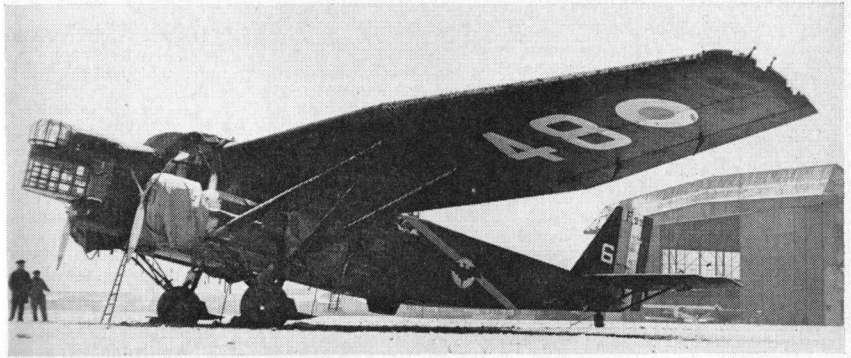
London, August 1967 William Green

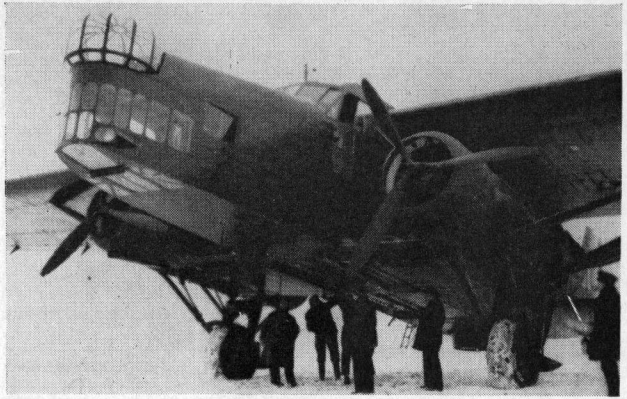
CENTRE (FARMAN) F 222 FRANCE

When the F 222 heavy bomber began to enter *Armée de l'Air* service in the spring of 1937, its appearance did nothing to dispell the widely-held belief that, to the French bomber designer, unrelenting ugliness was the natural accompaniment of efficiency: that cleanliness of line was effeminate. Drag-evoking battlements and bastions seemed to be as indispensable to the large French bomber as tail surfaces or an undercarriage. The progeny of the Farman company had never been noted for their aesthetic qualities, and the **F 222**, with its angular, slab-sided fuselage, immense wing and profusion of bracing struts, was no exception. It did make one concession to modernity, however, in that its main undercarriage members were retractable.

The F 222 was a progressive development of the F 221, and its prototype was, in fact, also the prototype of its predecessor. Work had begun at Toussus-le-Noble in August 1935 to fit the F 221.01 prototype with retractable main undercarriage members, the wheels being raised forwards into the engine nacelles. Apart from some redesign of the engine nacelles themselves, and their accompanying stub lower wing, no other changes were introduced, and the modified aircraft flew during the following winter as the **F 222 BN5** (*Bombardment de Nuit—Cinq-Place*) No. 01. At that time, the Farman plant at Billancourt was engaged in fulfilling a contract for 12 F 221 BN5 bombers and, completing these in April 1936, began work on a batch of 12 F 222 BN5 bombers. Progressive development of the basic design had, meanwhile, resulted in the introduction

F 222.1 *No.*6, *the sixth aircraft of GB* 1/15. *The lack of dihedral on the outboard wing panels was a distinguishing feature of this initial production variant*

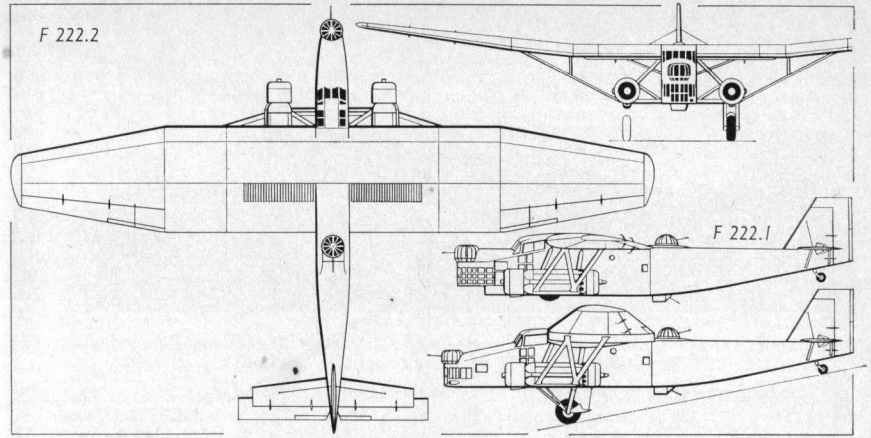




F 222.2 No.34 serving with the 15e Escadre in the winter of 1939–40. A noteworthy feature of this particular aircraft is its lack of dihedral on the outboard wing panels normally characteristic of the F 222.1

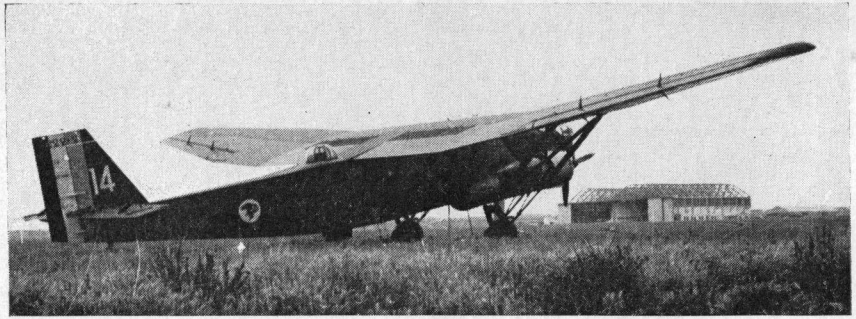
of marked dihedral on the wing outer panels, the elimination of the step beneath the bombardier's position, the lowering of the fuselage nose line, and the lengthening of the nose itself, and with these changes a further batch of eight machines was ordered on October 16, 1936 under the designation **F 222.2 BN5** (Nos. 13 to 20).

The 15e *Escadre* began conversion to the **F 222.1** bomber in April 1937, by which time the Farman concern had been fused with that of Hanriot under the nationalisation law to form the Société Nationale de Constructions Aéronautiques du Centre (SNCAC), and the new organisation had been awarded a contract for a further 16 F 222.2 BN5 bombers (Nos. 21 to 36), these differing from the initial batch only in having Gnôme-Rhône 14N 11/15 engines in place of the 14Kirs engines, the newer power plants offering increased cylinder head cooling area and improved carburettor. The first F 222.2 began official trials at the CEMA (*Centre d'Essais du Matériel Aérien*) in November 1937, and in March 1938, F 222.2 No. 26 was flown at Toussus-le-Noble with differentially-actuated ailerons, while, on



May 20, 1938, the last production aircraft, F 222.2 No. 36, was flown without dihedral on the outer wing panels, although this was to be reinstituted 11 days later.

The F 222.2 BN5 was of all-metal construction, the wing being a three-spar torsion box structure with a parallel chord centre section housing all fuel. The wing was attached directly to the top of the fuselage and was braced by N-struts to the extremities of the stub lower wings which supported the engines. The wing leading edges and main central torsion box girder had duralumin stressed-skin covering, the trailing edges being fabric covered. The rectangular-section fuselage had smooth stressed-skin covering, and was built in two sections joining at the wing trailing edge. A manually-operated turret with a single 7.5-mm. MAC 1934 machine gun was provided in the extreme nose, and pilot and co-pilot were seated side-by-side ahead of the wing leading edge. The 16.4-ft. weapons bay beneath the wing comprised four bomb containers capable of accommodating a maximum of 9,240 lb. of bombs and divided down the centre by a walkway providing access to the radio operator's compartment and to the manually-operated dorsal turret which, like the ventral "dustbin", housed a single 7.5-mm. MAC 1934 machine gun. The four Gnôme-Rhône 14K or 14N radials were mounted in tandem pairs, two functioning as tractors and two as pushers, in nacelles attached to the extremities of the lower stub wing and braced by inclined parallel struts to the fuselage.



F 222.2 *No.* 14, *the second production example of this variant of the bomber, serving with the* 2e *Escadrille of GB* 1/15 *which flew nocturnal missions over Germany*

OPERATIONAL CAREER

As the F 222.2 BN5s were completed they joined the F 222.1 BN5s in the 15e *Escadre* of the *Armée de l'Air*, and on July 1, 1939 the 43e *Groupe Aérien Autonome* was formed at Thiès, Senegal, with a mixed equipment which included five F 222s. Pending the reinforcement of the *Aéronavale* element based at Dakar, the F 222s of the 43e GAA flew anti-submarine and shipping patrols along the West African coastline in October–November 1939. The F 222.1s and F 222.2s of the 15e *Escadre* began operational sorties by night over Germany and Czechoslovakia on December 22, 1939, but its missions were confined to reconnaissance and leaflet dropping.

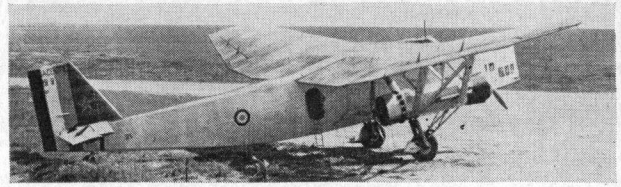
On April 15, 1940, the 15e *Escadre* was redesignated *Groupement* 15, comprising *Groupes de Bombardement* I/15 and II/15, and a month later, on May 14th, this unit began night bombing attacks against targets in the Rhineland, Württemburg and Bavaria. GB I/15 received some reinforcement on May 24th in the shape of the two NC 223.3s, and four aircraft of this type were also delivered to GB II/15 early in June, although the newer bomber was never flown operationally by the latter *Groupe*. Up to June 15th, when *Groupement* 15 was ordered to North Africa, GB I/15 had dropped 134,480 lb. of bombs and GB II/15 had delivered 159,240 lb. of bombs, and despite the low performance of its F 222.1s and 222.2s, *Groupement* 15 enjoyed the lowest loss rate of any *Armée de l'Air* operational unit, thanks to a combination of reliability and the fact that all sorties were flown at night, only one machine being lost and this as a result of a crash landing on the night of May 31st–June 1st.

In November 1939, F 222.1 No. 1 and F 222.2 Nos. 16 and 33 had been handed over by the *Armée de l'Air* to the *Aéronavale* which formed *Escadrille* 10E with these aircraft for maritime reconnaissance on November 22nd.

This unit was transferred from Orly to Casablanca on January 15th, 1940, and with two 220 Imp. gal. auxiliary fuel tanks occupying two of the four bomb compartments, the F 222s of 10E flew patrols over the Atlantic. One of 10E's trio of aircraft, christened *Arcturus*, was seconded to the 3e *Région Maritime* on June 14, 1940 and, until June 22nd this lone F 222 flew night bombing missions from its base in southern France against targets in Italy, including La Spezzia, Rossignano, Alghero and Liverno.

One of the aircraft, F 222.2 No. 19 which was with an *Armée de l'Air* supply unit, *Entrepôt* 301, at Saint-Jean d'Angély, escaped to St. Eval, Cornwall, on June 20, 1940, its crew joining the Free French. After the Armistice, on September 30, 1940, the Vichy authorities disbanded GB II/15, and on October 10th of that year GB I/15 became the *Groupe de Transport* I/15 with a mixture of F 222.1s and 222.2s, NC 223.3s and F 224s, and on November 8, 1942, GT I/15 was based at Salé in Morocco when the airfield was attacked by U.S. Navy Wildcat fighters. Several of its aircraft were destroyed but the unit continued to operate in the transport and communications role in the Mediterranean and Africa. GT I/15 was still operating F 222s when, on January 24, 1944, the unit was given the name *Touraine*. Eight months later, on September 9th, its F 222s were supplemented by four Douglas C-47s, and by the end of the year the last of GT I/15's converted heavy bombers had been withdrawn from service and scrapped.

F 222.2 *No.* 21 *of the* 1e *Escadrille of GT* 1/15 *photographed at Algiers-Maison Blanche in* 1942



CENTRE F 222.2 BN5 SPECIFICATION

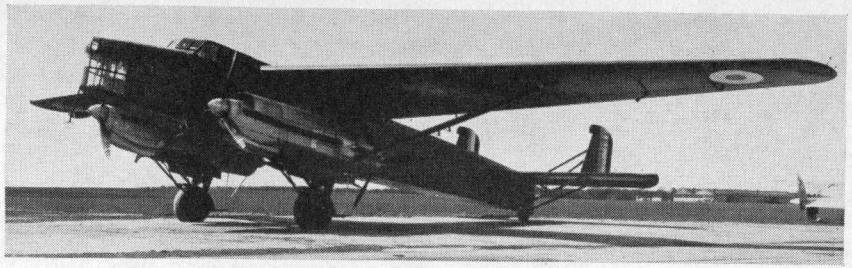
Type: *Five-seat Heavy Night Bomber.* **Power Plants:** *Four Gnôme-Rhône* 14*N* 11/15 14-*cylinder radial air-cooled engines each rated at* 950 *h.p. for take-off and* 970 *h.p. at* 15,000 *ft.* **Armament:** (*Defensive*) *One* 7.5-*mm. MAC* 1934 *machine gun in manually-operated nose and dorsal turrets and ventral dustbin.* (*Offensive*) *Twenty* 441-*lb.*, 40 220-*lb.*, *or mixture of* 441-*lb.*, 220-*lb. and* 110-*lb. bombs up to maximum of* 9,260 *lb.* **Performance:** (*F* 222.2) *Maximum speed,* 180 *m.p.h. at* 3,280 *ft.*, 193 *m.p.h. at* 9,840 *ft.*, 199 *m.p.h. at* 13,120 *ft.; cruising speed,* 174 *m.p.h. at* 13,120 *ft.; range with* 5,510-*lb. bomb load,* 1,240 *mls.; time to* 3,280 *ft.*, 3 *min.* 5 *sec., to* 9,840 *ft.*, 9 *min.* 40 *sec., to* 13,120 *ft.*, 13 *min.* 30 *sec.; service ceiling,* 26,250 *ft.* **Weights:** *Empty,* 23,122 *lb.; normal loaded,* 33,510 *lb.; maximum loaded,* 41,226 *lb.* **Dimensions:** *Span,* 118 *ft.* 1¼ *in.; length,* 70 *ft.* 4½ *in.; height,* 17 *ft.* 0⅜ *in.; wing area,* 2,002.083 *sq. ft.*

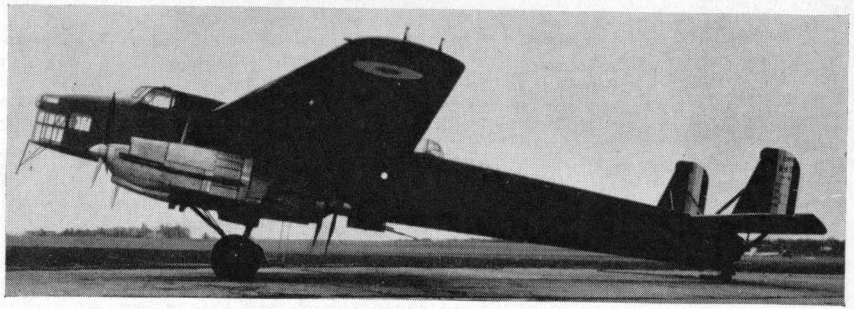
Although it might be assumed from its designation that the F 223 (alias NC 223) was a progressive development of the F 222, in fact, other than sharing a design formula manifestly outdated by world progress, this heavy bomber had nothing in common with its predecessor. The last heavy bomber to be designed by the Farman company prior to its nationalisation as part of the Société Nationale de Constructions Aéronautiques du Centre (SNCAC), the F 223 offered a peculiar blend of the modern and the archaic in design; a clean, relatively high aspect ratio wing being externally braced and married to a flat-sided, rectangular-section fuselage and strut-mounted tandem-engine nacelles.

The **F 223** had been designed in 1936 as a potential successor to the F 222 then in production for the *Armée de l'Air*, but calculations of the range that would be attainable if the bomb load be replaced by additional fuel led the *Ministère de l'Air* to order the first prototype as a long-range mailplane under the designation **F 223.1 No. 01,** and registered F-APUZ, this aircraft was flown for the first time at Toussus-le-Noble by Lucien Coupet in June 1937. Powered by four Hispano-Suiza 12Xirsl 12-cylinder liquid-cooled engines each rated at 720 h.p., the aircraft was redesignated **NC 223.1** with the absorption of the Farman plant at Billancourt by the SNCAC on March 1, 1937, and on October 17th established an international record by flying a distance of 621 miles with a 22,046-lb. load at an average speed of 163 m.p.h. Christened *Chef-Pilote Laurent Guerrero*, the NC 223.1 possessed a range of 4,970 miles, and was subsequently operated by Air France over the South Atlantic.

The second aircraft to be completed, the NC 223 No. 01, was, in fact, the first prototype for the bomber, and was externally similar to the mailplane, the only differences being the internal arrangements and the engines which were Hispano-Suiza 14AA 14-cylinder two-row air-cooled radials each rated at 1,000 h.p. at 13,120 ft. The **NC 223 No. 01** flew at Toussus-le-Noble on January 18, 1938, and, after manufacturer's trials, was flown to Villacoublay on May 31st for tests at the *Centre d'Essais du Matériel Aérien* (CEMA). However, the poor reliability of the HS 14AA radials constantly interrupted the flying programme, and on June 18th the prototype was returned to the SNCAC for the installation of Hispano-Suiza 12Y 29 12-cylinder liquid-cooled engines rated at 910 h.p. for take-off and 920 h.p. at 10,970 ft. In the meantime, the SNCAC had proposed a version powered by Gnôme-Rhône 14N radials as the **NC 223.2**, although this model was not destined to be developed, and thus the re-engined prototype, which resumed flight testing on October 15, 1938, received the designation **NC 223.3 No. 01.**

Initial trials with the NC 223.3 proceeded satisfactorily until December 23, 1938, when, during a high-altitude flight, the hydraulic jacks of the undercarriage froze solid, and refused to function when the aircraft descended to lower altitudes, necessitating a crash landing in which some damage was suffered. This accident delayed the continuation of the flight test programme until February 4, 1939, the prototype not being available for further CEMA trials until March 27th. By this time, an initial batch of eight **NC 223.3 BN5** bombers had been ordered by the *Ministère de l'Air*, and production was already in hand at Billancourt where the first aircraft was completed late in 1939 and flown from Toussus-le-Noble. The second production NC 223.3 flew on January 10, 1940, and the eighth and last

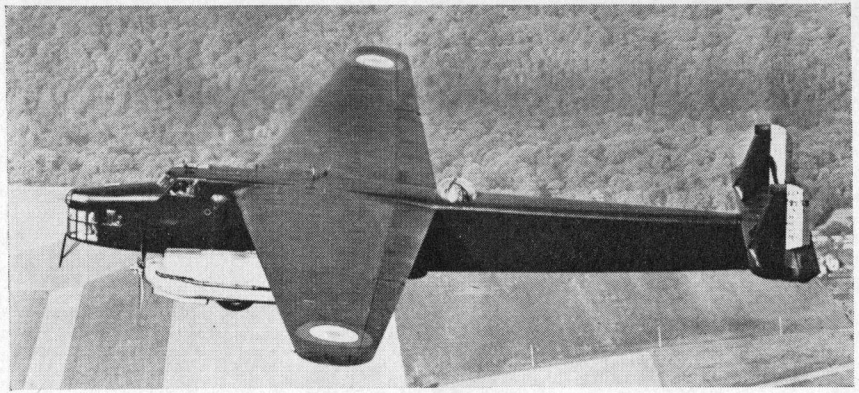




(*Above and below*) *The NC* 223.3 *No.*01 *which was initially flown with Hispano-Suiza* 14*AA radials as the NC* 223 *No.*01. *It first flew in the form illustrated in October* 1938

of the initial batch followed on March 28th, work continuing on a further batch against a supplementary order placed in the previous year.

The NC 223.3 was powered, like the prototype, by four Hispano-Suiza 12Y 29 engines mounted in tandem pairs below the wings and driving two tractor and two pusher airscrews. The all-metal wing comprised three spars interconnected with trellis ribs and covered by smooth duralumin sheet. It was built in two halves, each half-wing attaching directly to the fuselage mainframes and braced by a single strut each side to the engine nacelles which, in



The NC 223.3 No.01 photographed during initial flight trials. The production model, which was externally similar, did not enter service until late May 1940

turn, were braced by a series of struts to the top and bottom of two fuselage mainframes. The hydraulically-operated main undercarriage members retracted forwards into bays in the engine nacelles. The rectangular-section all-metal fuselage had stressed metal skinning, and accommodated the bombardier-navigator in the extreme nose with a single 7.5-mm.

CENTRE NC 223 BN5 SPECIFICATION

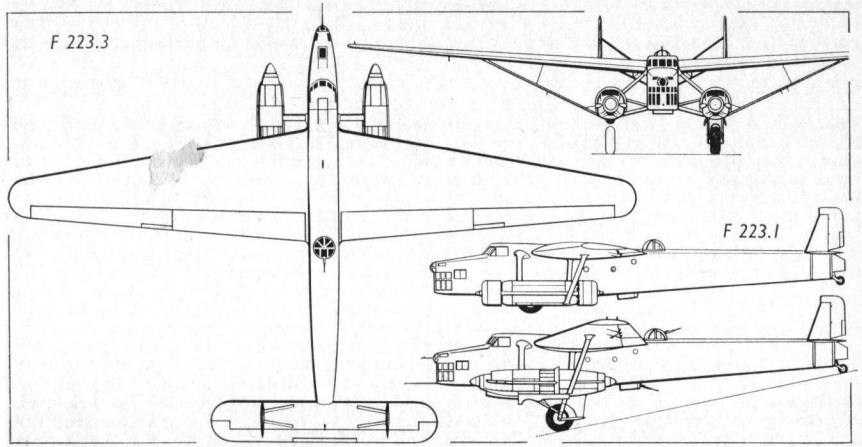
Type: *Five-seat Heavy Bomber and Six-seat Patrol Bomber.* **Power Plants:** *Four Hispano-Suiza 12Y 29 12-cylinder liquid-cooled engines each rated at 910 h.p. for take-off and 920 h.p. at 10,970 ft.* **Armament:** (*Defensive*) *One 7.5-mm. MAC 1934 machine gun on flexible mount in extreme nose, one 20-mm. Hispano-Suiza 404 cannon in power-operated Type 200 SAMM dorsal turret, and one 20-mm. Hispano-Suiza 404 cannon in power-operated Type 109 SAMM ventral turret.* (*Offensive*) *Maximum bomb load of 9,240 lb. housed by four internal bays.* **Performance:** *Maximum speed, 217 m.p.h. at 4,920 ft., 248 m.p.h. at 13,120 ft.; cruising speed, 174 m.p.h. at 4,920 ft., 199 m.p.h. at 13,120 ft.; range, 1,490 mls.; time to 13,120 ft., 10 min.; absolute ceiling, 26,240 ft.* **Weights:** *Empty, 23,258 lb.; maximum loaded, 42,329 lb.* **Dimensions:** *Span, 110 ft. 2 in.; length, 72 ft. 2 in.; height, 16 ft. 8 in.; wing area, 1,425 sq. ft.*

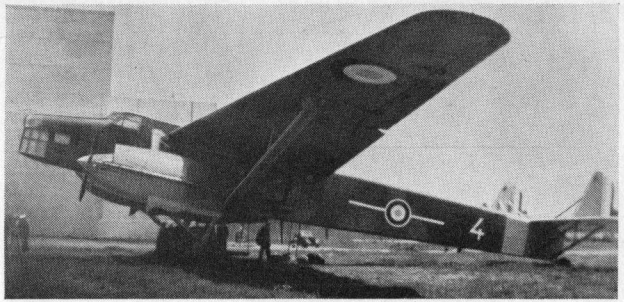
machine gun on a flexible mounting, a radio operator immediately ahead and below the flight deck on which the pilot and co-pilot were seated side-by-side, and aft of the bomb-bay, which was divided by a central catwalk, were power-operated dorsal and ventral turrets each housing a 20-mm. Hispano-Suiza HS 404 cannon. All fuel tanks were housed within the wing, total fuel capacity being 1,320 Imp. gal.

OPERATIONAL CAREER

The first two NC 223.3 bombers were delivered to *Groupe de Bombardement* I/15 on May 24, 1940, and these participated in night attacks on Germany alongside the unit's F 222s during the first two weeks of June. GB I/15 possessed four NC 223.3s (Nos. 2, 4, 8 and 9) when, on June 15th, the unit was ordered to fly to North Africa, and its companion *Groupe*, GB II/15 had received a similar number of NC 223.3s, although these had not been used operationally as their crews were still in process of conversion when GB II/15 was ordered to North Africa, one of the four being left behind (No. 14) owing to damage suffered in a heavy landing at Saint-Yan.

In July 1940, GB I/15 was ordered to hand over three of its NC 223.3 bombers to Air France for conversion as long-range communications and mail-carrying aircraft, and these (Nos. 2, 8 and 9) became F-BAFM, F-BAFR, and F-BAGR. GB II/15 also passed one of its NC 223.3s to Air France (No. 10) as F-BAAG, and these aircraft were fitted with seats for eight passengers and supplementary fuel tanks in the weapons bay which increased





An NC 223.3 operated in the transport role by GT 1/15 in the Vichy-controlled Armée de l'Air

total capacity to 2,068 Imp. gal. Yet another NC 223.3 had found its way to the Levant and was being operated bythe Free French airlines under the registration FL-AFM on services between here, Madagascar and Central Africa, and the remainder were operating as transports alongside several F 222s and F 224s with the Vichy-controlled *Groupe de Transport* I/15 from Salé in Morocco and Algiers-Maison Blanche, GB I/15 having converted to the transport role on October 10, 1940, taking over the remaining NC 223.3s of GB II/15 which had been disbanded on September 30, 1940.

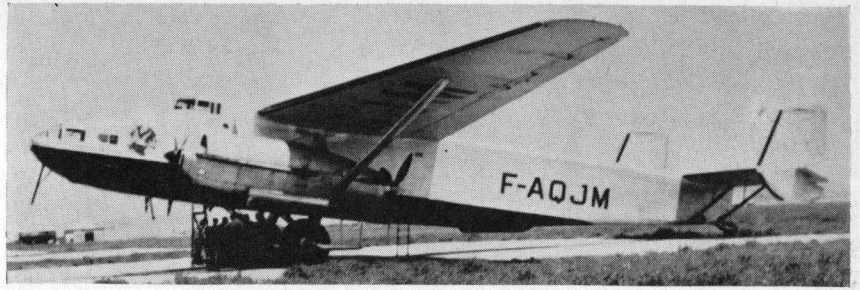
CENTRE NC 223.4

FRANCE

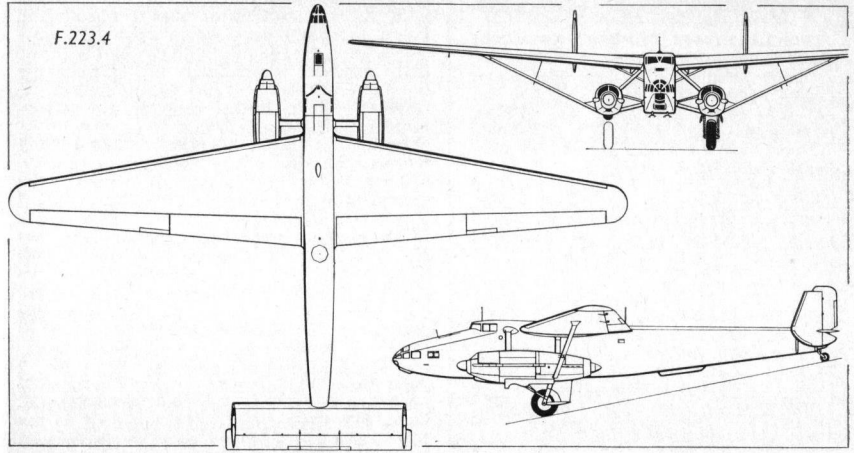
The Second World War saw innumerable aircraft adapted to undertake tasks never forseen by their designers, but the conflict saw no more remarkable a transformation than that undergone by the **NC 223.4** which, intended for use as a transatlantic mailplane, was pressed into service as a strategic bomber and, what is more, gained the distinction of becoming the first Allied bomber to attack Berlin!

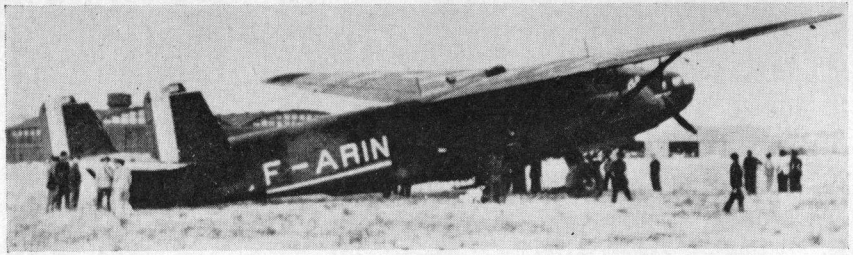
The NC 223.4 had been evolved in parallel with the NC 223.3 heavy bomber to meet a specific Air France Transatlantique requirement for a high-speed mailplane for operation across the North and South Atlantic. Utilising the wings, engine installation and undercarriage of the bomber, the NC 223.4 was less offensively angular than its more militant counterpart, its somewhat deeper fuselage featuring a gracefully curved semi-glazed nose section and a shallower stepped cockpit windscreen. Three aircraft were ordered, the first of which flew on March 15, 1939 at Toussus-le-Noble, subsequently being registered F-AQJM and named *Camille Flammarion*.

When, late in 1937, the former Farman design team under the leadership of Marcel Roca had initiated development of the NC 223.4, it had been planned to house the five crew members in a semi-pressurized forward fuselage, a cruising altitude of some 26,000 ft. being envisaged, but the limited knowledge available at that time concerning pressure cabin structures soon led to a less ambitious goal, and proposals for pressurization had been shelved. The crew of the NC 223.4 was housed in the forward fuselage ahead of the wings, the



The first example of the NC 223.4, the Camille Flammarion, photographed at Marignane in 1940 after reconversion for civil tasks with Air France





The NC 223.4 Jules Verne with commercial registration restored but still retaining the night-bomber finish in which it made its historic attack on Berlin

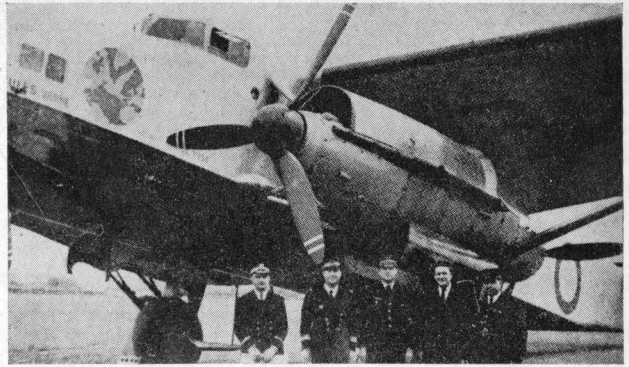
CENTRE NC 223.4 SPECIFICATION

Type: *Long-range Maritime Reconnaissance Conversion.* **Power Plants:** *Four Hispano-Suiza 12 Y 37 12-cylinder liquid-cooled engines each rated at* 1,050 *h.p. for take-off and* 970 *h.p. at* 4,100 *ft.* **Armament:** (*Defensive*) *One hand-held 7.5-mm. Darne machine gun in rear starboard entry door.* (*Offensive*) *A maximum of eight* 551-*lb. bombs on external racks.* **Performance:** *Maximum speed,* 239 *m.p.h. at* 10,825 *ft.,* (*with maximum bomb load*) 212 *m.p.h. at* 4,920 *ft.; maximum cruising speed,* 211 *m.p.h. at* 13,120 *ft.,* (*with maximum bomb load*) 170 *m.p.h. at* 4,920 *ft.; range* (*with maximum bomb load*), 3,107 *mls.,* (*with maximum fuel*) 4,970 *mls.; service ceiling at maximum loaded weight,* 13,120 *ft.* **Weights:** *Empty,* 22,046 *lb.; maximum loaded,* 52,911 *lb.* **Dimensions:** *Span,* 110 *ft.* 2 *in.; length,* 77 *ft.* 1 *in.; height,* 15 *ft.* 11 *in.; wing area,* 1,425 *sq. ft.*

navigator's station being in the extreme nose, with the radio-operator seated ahead and below the flight deck which offered side-by-side seating for the pilot and co-pilot with the flight engineer immediately aft. Unlike the bomber equivalent, all fuel was housed in the fuselage, eight tanks beneath the wings housing 3,080 Imp. gal.

For initial flight trials, the **NC 223.4 No. 1** had Hispano-Suiza 12Y 39 engines offering 910 h.p. at 11,155 ft. which also powered the second and third machines, **NC 223.4 No. 2** F-ARIN *Jules Verne* and **NC 223.4 No. 3** F-AROA *Le Verrier*. In October 1939, the NC 223.4 No. 1 *Camille Flammarion* was flown by an Air France crew from France to Rio de Janeiro ostensibly for development purposes but, in fact, to participate in the search for the German vessels *Admiral Graf Spee* and *Admiral Scheer*, and shortly afterwards, the second machine, NC 223.4 No. 2 *Jules Verne*, was handed over to the *Aéronavale* for maritime reconnaissance. The Hispano-Suiza 12Y 39 engines were supplanted by HS 12Y 37s rated at 970 h.p. at 4,100 ft. and

The Jules Verne with the crew that attacked Berlin



1,050 h.p. for take-off, eight racks for bombs of up to 551 lb. were fitted beneath the fuselage, and a single 7.5-mm. Darne machine gun—of greater value to crew morale than to defence—was fitted on a flexible mount in the rear starboard entry door.

In the meantime, the decision had been taken to similarly convert NC 223.4 Nos. 1 and 3 to equip a new *Aéronavale* unit, *Escadrille* B5, but when B5 was eventually formed at Orly in May 1940 only NC 223.4 No. 2 *Jules Verne* had been completely converted and was available for operations. Bearing service markings, the *Jules Verne* was immediately assigned to night bombing operations rather than maritime reconnaissance as originally envisaged, its first sortie being an attack on the Maestricht bridge on May 13th. The *Jules Verne* subsequently made night sorties against targets in Germany, Belgium and the Netherlands, but it was on the night of June 7th–8th that this converted mailplane made its claim for inclusion in the history of military aviation by becoming the first Allied aircraft to bomb Berlin in the Second World War. Thanks to its 3,107-mile range with a 4,409-lb. bomb load, the *Jules Verne* took-off from Bordeaux-Mérignac, flew up the channel, skirted the Dutch coastline, crossed Denmark and the Baltic and then flew southwards to Berlin, a direction from which the Germans hardly expected an attack on their capital. Taking maximum advantage of the element of surprise, the *Jules Verne* dropped its bombs and then flew back across Germany and North-East France to land at Orly at dawn after a 13.5-hour flight.

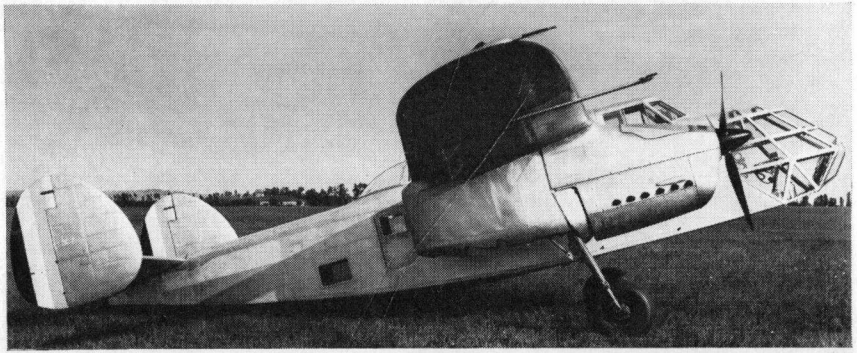
A few sorties were flown over Italy until the Armistice brought a halt to the activities of *Escadrille* B5, which, on August 1, 1940, was redesignated 5B, subsequently converting to Martin 167s, the trio of NC 223.4s being returned to Air France, reconverted for civil tasks and their commerical registrations restored. The NC 223.4 No. 3 *Le Verrier* was shot down during a flight to the Levant on November 27, 1940, when its pilot, Guillaumet, inadvertently flew into the midst of an Anglo-Italian air-naval battle in the Mediterranean. The remaining two NC 223.4s were in France's southern zone when German forces occupied the area in November 1942, but their ultimate fate is unknown.

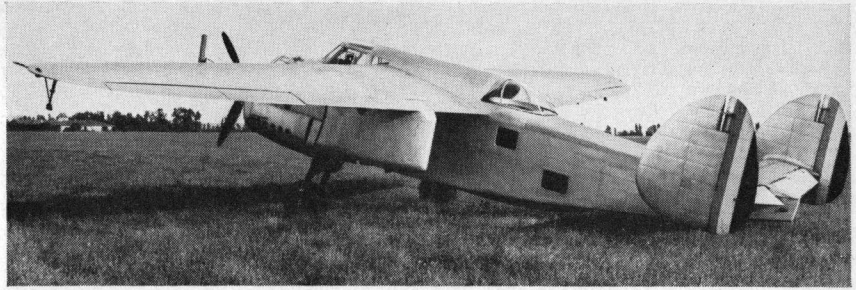
DEWOITINE D.720 FRANCE

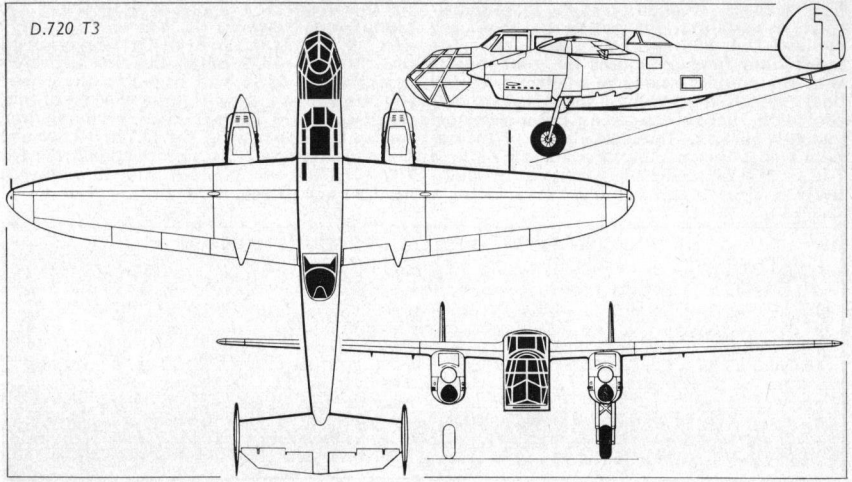
During the course of 1937, the *Service Technique de l'Aéronautique* prepared a requirement for a T3 (*Triplace de Travail*) aircraft, a light three-seat twin intended to perform a variety of roles ranging from tactical reconnaissance and army co-operation to light bombing and crew training. To meet this requirement, the Société Nationale de Constructions Aéronautiques du Midi (SNCAM) began the design of the **D.700 T3** in January 1938, this being a cantilever shoulder-wing monoplane with a ventral gondola, a fixed undercarriage and a pair of Renault 6Q six-cylinder inline inverted air-cooled engines of 220 h.p. hung as pods beneath the wing. The first metal was cut on the D.700 T3 in May 1938, but shortly afterwards the Air Staff concluded that it was preferable to house an observer in the nose of an aircraft rather than in a ventral gondola, this decision necessitating the complete redesign of the fuselage, and as by this time it had been ascertained that the performance of the D.700 T3 would not meet the demands of the requirement, the opportunity was taken to switch to Renault 12R 00/01 twelve-cylinder engines offering 500 h.p. at sea level and 450 h.p. at 11,800 ft., the revised aircraft being redesignated **D.720 T3.**

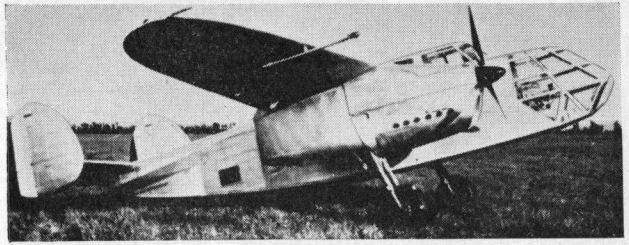
Construction of the prototype continued at Toulouse, during the course of which the decision was taken to replace the fixed, faired undercarriage by hydraulically-retractable Olaer main members housed in the engine nacelles. The single-spar wing was built in three sections. The centre section was bolted to the tops of the fuselage mainframes, housed

(*Below and above right*) *The D.720 No. 01 photographed at Toulouse-Francazals on July 18, 1939, a week after its initial flight with Marcel Doret at the controls*









two 27.4 Imp. gal. fuel tanks and had light alloy skinning, and the outer panels were fabric covered apart from the detachable metal leading edges. In addition to the main undercarriage members, the engine nacelles each contained a 99 Imp. gal. fuel tank. The monocoque fuselage housed the pilot to port with the co-pilot seated in tandem with full dual controls, a catwalk on the starboard side providing access to the radio-operator/gunner's cockpit. Immediately aft of the co-pilot's seat was a mounting for an oblique F30 or F50 or vertical F70 camera. Alternatively, a Type F and two Type J racks for a total of 20 22-lb. bombs could be installed in this position. A single fixed forward-firing 7.5-mm. gun was to be installed for the pilot, and the radio-operator / gunner had twin 7.5-mm. guns in a manually-operated SAMMAB33 dorsal turret, and a similar weapon on a flexible mounting firing through a hatch in the floor.

The **D.720 No. 01** was flown for the first time at Toulouse-Francazal by Marcel Doret on July 10, 1939, and after the completion of the manufacturer's flight test programme, the aircraft was flown to the *Centre d'Essais du Matériel Aérien* (CEMA) at Orléans-Bricy on September 25, 1939, but by this time deliveries of the Potez 63.11 had begun to the *Armée de l'Air*, and as a crew training variant of this, the Potez 63.16 T3, was nearing completion, further development of the D.720 T3 seemed pointless. Nevertheless, a production order for 1,000 D. 720s was planned in 1940, although never in fact placed.

DEWOITINE D.720 T3 SPECIFICATION

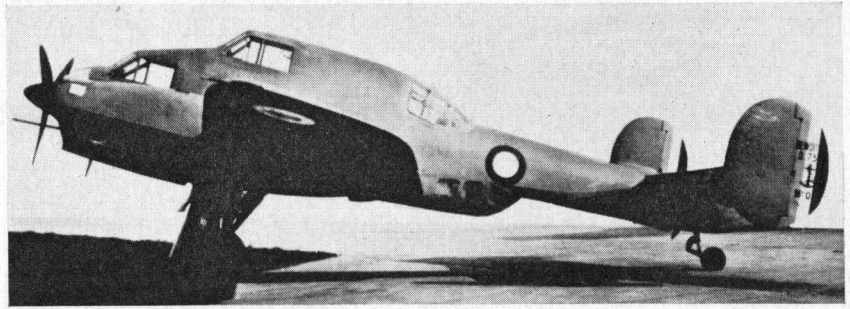
Type: *Three-seat Army Co-operation and Tactical Reconnaissance Aircraft.* **Power Plants:** *Two Renault 12R 00/01 12-cylinder inverted-Vee air-cooled engines each rated at 500 h.p. for take-off and 450 h.p. at 11,800 ft.* **Armament:** *One fixed forward-firing 7.5-mm. MAC 1934 machine gun with two 300-round drums, two 7.5-mm. MAC 1934 machine guns with eight 100-round drums in manually-operated dorsal turret, and one 7.5-mm. MAC 1934 machine gun on flexible mounting firing through ventral hatch, plus 20 22-lb. bombs and 24 flares.* **Performance:** *Maximum speed, 224 m.p.h. at 11,810 ft.; maximum cruising speed, 205 m.p.h. at 9,840 ft.; endurance at maximum cruising speed, 4.5 hr.; climb to 13,120 ft., 10 min.; service ceiling, 27,560 ft.* **Weights:** *Empty (without armament), 5,774 lb.; maximum loaded, 8,426 lb.* **Dimensions:** *Span, 48 ft. 10¾ in.; length, 34 ft. 5⅛ in.; height, (tail up)12 ft. 2¾ in.; wing area, 298.16 sq. ft.*

DEWOITINE D.750 — FRANCE

Evolved as a competitor for the C.A.O.600 in meeting the requirements of *Programme Technique* A47 which called for a twin-engined shipboard torpedo- and reconnaissance-bomber for use from the planned aircraft carriers *Joffre* and *Painlevé*, the D.750, designed by the former Dewoitine team of the Société Nationale de Constructions Aéronautiques du Midi (SNCAM), employed a very similar configuration to that of the SNCAO contender for *Ministère de la Marine* orders. Two prototypes of the D.750 were ordered by the *Ministère de l'Air* on behalf of the *Ministère de la Marine* on July 26, 1939, these conforming with *Edition* No. 3 of A47 issued on January 10, 1938, and construction was initiated at Toulouse.

The **D.750** was of all-metal stressed-skin construction with a low-set wing of typical Dewoitine single-spar structure and two Renault 12R 06/07 12-cylinder inverted-Vee air-cooled engines driving variable-pitch Ratier 1716 electric airscrews of 7 ft. 6¼ in. diameter. Immediately outboard of the engine nacelles, the tapered outer wing panels swivelled on the mainspar to fold aft. All fuel was housed in the parallel-chord wing centre section, two 55 Imp. gal. tanks being mounted between the engine nacelles and the fuselage, and two 35 Imp. gal. tanks being positioned outboard of the engines. The main members of the Messier undercarriage retracted aft into the engine nacelles, and the fuselage housed either two or three crew members in conformity with the naval specification; pilot, navigator-bombardier and radio-operator/gunner being carried for the reconnaissance and level bombing missions but only pilot and

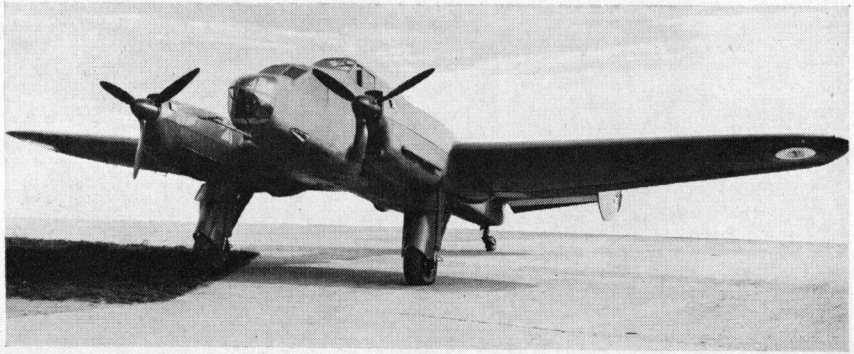
The D.750 No.01 photographed at Toulouse-Francazals on May 20,1940, two weeks after the commencement of the flight test programme

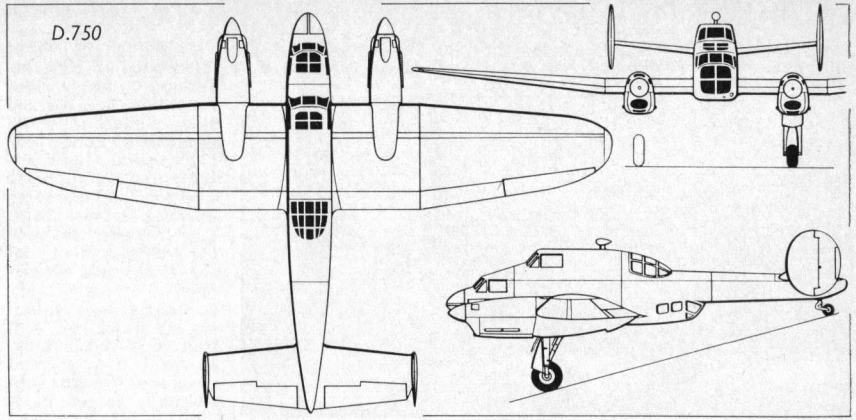


radio-operator/gunner being carried for torpedo-bombing and smoke screen-laying missions. The navigator-bombardier was accommodated in the extreme nose, his cockpit, which featured its own individual windscreen, being provided with auxiliary controls; the pilot was seated above and to port, with a catwalk to starboard providing communication between the navigator-bombardier and radio-operator/gunner aft who operated the SIF 450 R/T set and a pair of aft-firing 7.5-mm. Darne machine guns, the upper gun having a Blanchet-Pilain-60 flexible mounting and the lower gun having a Blanchet-Pilain-13 mount. The third defensive weapon was a fixed, forward-firing Darne machine gun which was operated by the pilot with the aid of an OPL 38 sight. The ventral Alkan 126 rack could carry a 992-lb. Type P bomb, a 1,432-lb. torpedo, or a 132 Imp. gal. torpedo-shaped auxiliary fuel tank, and alternative loads included four 330-lb. Type I2 or two 496-lb. Type K bombs, while two 165-lb. G2 bombs were to be carried on reconnaissance

The components of the first prototype, the **D.750 No. 01**, were transported from the Toulouse plant to nearby Francazals airfield early in 1940, and the initial flight was made on May 6th with the SNCAM's chief test pilot, Marcel Doret, at the controls. Manufacturer's flight trials were still in their early stages when the entire programme was halted on June 25, 1940, the first prototype being scrapped and the second abandoned prior to completion, a tragic end to an extremely promising programme.

Evolved in competition with the C.A.O.600 (see Volume VII), the D.750 was intended to meet Programme Technique A47, an extremely advanced requirement calling for a multi-purpose twin-engined shipboard aircraft at a time when some major powers were still reluctant to relinquish the biplane in favour of the monoplane. In the event, the first twin-engined shipboard monoplanes were not to enter service for more than a decade after the formulation of the A47 requirement

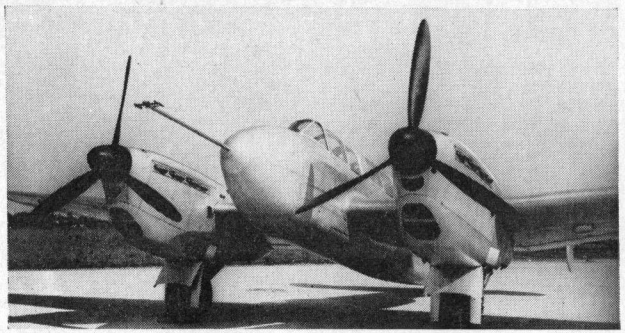


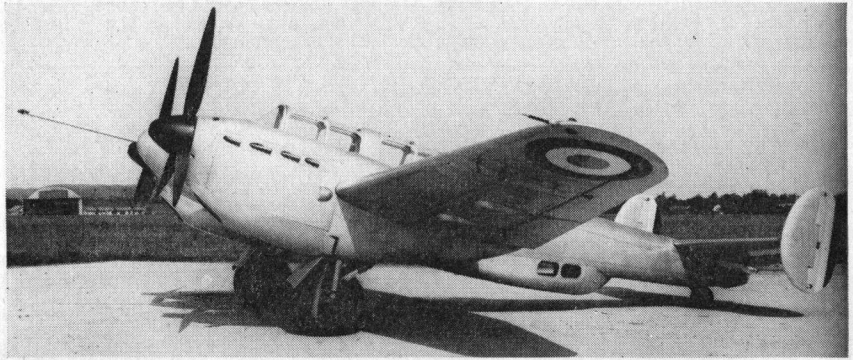


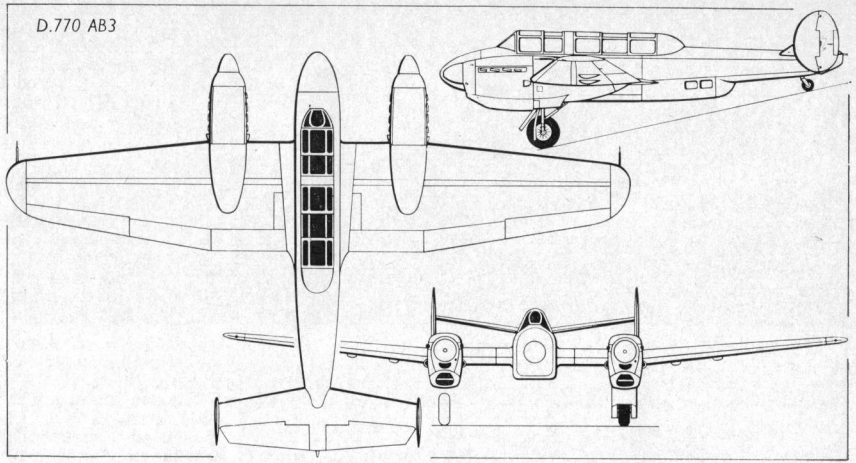
DEWOITINE D.750 SPECIFICATION

Type: *Two-seat Shipboard Torpedo-bomber and Three-seat Reconnaissance-bomber.* **Power Plants:** *Two Renault 12R 06/07 12-cylinder air-cooled inverted-Vee engines each rated at 500 h.p. for take-off and 450 h.p. at 4,920 ft.* **Armament:** (*Defensive*) *One fixed forward-firing 7.5-mm. Darne machine gun with 300 rounds, one 7.5-mm. Darne machine gun with 700 rounds on flexible mounting in dorsal position, and one 7.5-mm. Darne machine gun with 300 rounds on flexible mounting in ventral position.* (*Offensive*) *One 1,433-lb. torpedo or one 992-lb., two 496-lb. or four 330-lb. bombs.* **Performance:** *Maximum speed, 222 m.p.h. at 4,920 ft.; economical cruising speed, 149 m.p.h. at 3,280 ft.; maximum cruising speed, 177 m.p.h. at 6,560 ft.; endurance* (*specified*), *6 hr. at 149 m.p.h. at 3,280 ft. with auxiliary ventral tank,* (*torpedo-bombing mission*), *3.5 hr.; maximum range, 900 mls.* **Weights:** *Empty, 6,431 lb.; loaded* (*reconnaissance mission*) *9,418 lb.,* (*torpedo-bombing mission*) *9,903 lb.* **Dimensions:** *Span, 52 ft. 2 in.; length, 34 ft. 1 in.; height, 9 ft. 5¾ in.; wing area, 388.79 sq. ft.*

Every major air power appreciated the fact that much was to be gained by close study of the Spanish Civil War, and although the lessons of this conflict were interpreted in differing fashion by the various air staffs, there seemed to be almost universal agreement concerning the value of attack aircraft in softening enemy positions and harassing enemy columns. Most countries persisted with the development of the traditional single-engined attack aircraft, in some cases combining the attack role with that of dive-bombing. In the U.S.A. a trend developed towards substantially larger twin-



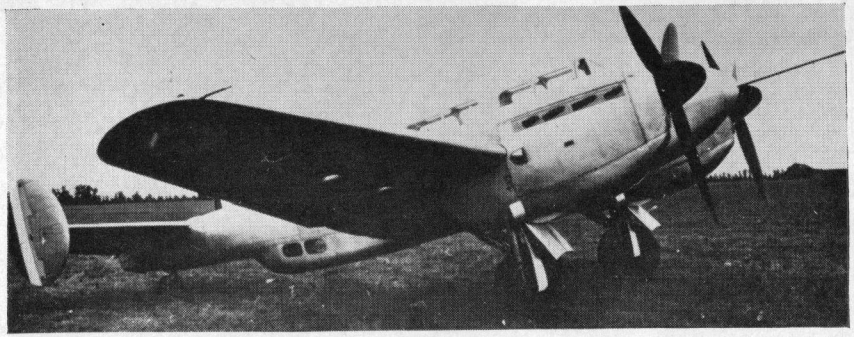


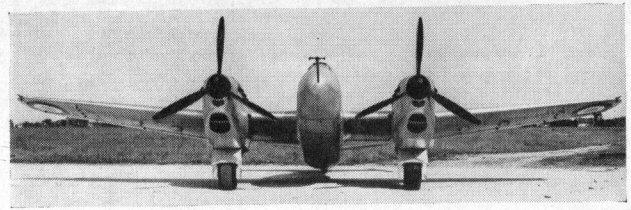


engined attack aircraft which, by European standards then appertaining, almost trespassed on the province of the medium bomber, resulting in such types as the Martin 167 and Douglas DB7. Capable of carrying substantially larger offensive loads than their single-engined forerunners at comparable speeds, these larger aircraft were potentially more versatile. While sharing a preference for the twin-engined attack aircraft, the French Air Staff tended towards rather smaller warplanes for this role, and France's aircraft industry was, apart from that of Italy which toyed briefly with the Breda 88, alone in developing relatively small, high-performance, twin-engined attack aircraft.

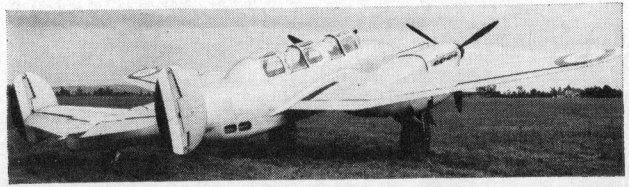
This trend had begun in 1938 with the adoption of the Breguet 691 AB2, but stemmed from the previous year and *Programme Technique* A51 initiated on August 17, 1937, calling for an AB2 (*Assaut Bombardement—Biplace*), a three-seat attack bomber designed for this role from the outset and a potential successor to the Bre 691 which had stemmed from a fighter specification. To meet new requirements the former Dewoitine design team of the Société Nationale de Constructions Aéronautiques du Midi (SNCAM) proposed the **D.770**, a clean mid-wing cantilever monoplane powered by two Hispano-Suiza 12Yjrs/krs liquid-cooled engines, an alternative model with Gnôme-Rhône 14N 02/03 air-cooled radials being the **D.771.**

Prototypes of both versions were ordered by





(Above and below) The D.770 AB3 No.01 was one of the most promising French combat aircraft under test in mid-1939



the *Ministère de l'Air*, construction commencing at the SNCAM's Toulouse plant. The D.770 and D.771 possessed essentially similar airframes of all-metal, stressed-skin construction with metal-framed, fabric-covered movable control surfaces. The wing employed an NACA 23015 aerofoil section, was of standard Dewoitine single-spar construction, and comprised a parallel-chord centre section and tapered outer panels. All fuel was housed in the wings, a total of 264 Imp. gal. being distributed between two tanks in the centre section and six in the outer panels. The fuselage was of rectangular section and was built in one piece apart from the nose cone which housed the forward-firing armament of one 20-mm. cannon and two 7.5-mm. machine guns, the line of fire of which could be raised or lowered hydraulically through 0–15° and which were aimed by the pilot by means of a Baille-Lemaire GH 39 gun sight. The internal weapons bay beneath the tandem cockpits could house up to eight 110-lb. bombs on Alkan-AL51 racks, and defensive armament comprised a single 7.5-mm. machine gun on a flexible SAMM-AB20 mounting in the dorsal position, and twin 7.5-mm. weapons on a flexible SAMM-AB22 mounting firing from the ventral step. The navigator, who operated the Radio-Industrie 537 R/T equipment, was provided with auxiliary controls, and the three crew members were protected by 330 lb. of armour. All three members of the undercarriage were hydraulically retractable, and the weapons-bay doors were also hydraulically actuated.

The **D.770 No. 01** was completed at Toulouse in the late spring of 1939, transported to the Francazals airfield where it was assembled and flown by Marcel Doret on June 27, 1939. Flight trials were delayed by engine cooling problems which necessitated some redesign and enlarging of the engine radiator air intakes. Manufacturer's tests proceeded slowly, and in December 1939, the **D.771 No. 01** was completed at Toulouse. However, this second aircraft was destined never to be flown as, by this time, the French Air Staff favoured the larger and more versatile Bloch 175; there was an urgent need to concentrate production on fewer and less-specialized aircraft types and, moreover, the SNCAM team was fully extended with more urgent projects, such as the D.551.

Flight testing of the D.770 continued at Francazals, but the prototype had not been delivered to the *Centre d'Essais du Matériel Aérien* (CEMA) for official trials when testing terminated in June 1940. The D.771 No. 01 was powered by two Gnôme-Rhône 14N 02/03 14-cylinder radials rated at 1,050 h.p. at 4,150 ft. and 1,085 h.p. at 7,260 ft., and was expected to have a slightly superior performance to that of the D.770. It was briefly resurrected in 1941 when, after the SNCAM was absorbed by the SNCASE, plans were formulated to fit a nosewheel undercarriage to the D.771 for flight testing. In the event, this modification was not undertaken, and both D.770 and D.771 were scrapped.

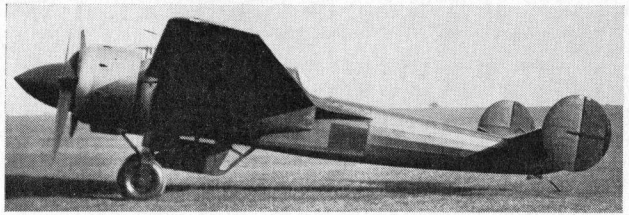
DEWOITINE D.770 SPECIFICATION

Type: *Three-seat Attack Bomber.* **Power Plants:** *Two Hispano-Suiza 12Yjrs2C7/krs2C7 12-cylinder liquid-cooled engines each rated at* 1,050 *h.p. for take-off and* 960 *h.p. at* 8,200 *ft.* **Armament:** (*Offensive*) *One forward-firing* 20-*mm. Hispano-Suiza* 404 *cannon with* 60 *rounds and two forward-firing* 7.5-*mm. MAC* 1934 *machine guns with* 500 *r.p.g., plus eight* 110-*lb. bombs.* (*Defensive*) *One* 7.5-*mm. MAC* 1934 *on flexible mounting with* 582 *rounds in dorsal position and two* 7.5-*mm. MAC* 1934 *machine guns on flexible mounting with* 582 *r.p.g. firing from ventral step.* **Performance:** *Maximum speed,* 312 *m.p.h. at* 10,500 *ft.,* 280 *m.p.h. at sea level; service ceiling,* 27,230 *ft.* **Weights:** *Empty (without armour and armament),* 8,814 *lb.; maximum loaded,* 13,453 *lb.* **Dimensions:** *Span,* 49 *ft.* 10½ *in.; length,* 31 *ft.* 11¾ *in.; height,* 10 *ft.* 7 *in.; wing area,* 320.879 *sq. ft.*

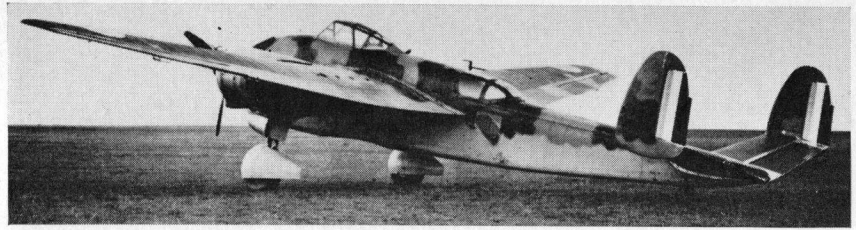
HANRIOT NC-530 FRANCE

One lesson taught forcefully by the fighting in France and the Low Countries during May–June 1940 was that the relatively slow tactical reconnaissance and army co-operation aircraft, upon which so much reliance had been placed by field forces, could not operate with impunity over the battlefield unless enjoying the protection of fighter cover. Thus, the *avions de travail*, as such aircraft were dubbed by the French, died as a concept during the first year of World War II, their activities subsequently being confined to areas in which they were unlikely to encounter enemy fighters and to nocturnal tasks. Prior to the debacle of the classic tactical reconnaissance and army co-operation aircraft in 1940, however, considerable effort was expended on the development of such aircraft, and in no country more than in France.

In 1936, the *Service Technique de l'Aéronautique* had formulated a requirement for a light three-seat twin-engined aircraft, a *Triplace de Travail*, intended to fulfil a range of tasks from frontline observation and army co-operation to tactical reconnaissance and light bombing. To meet this requirement, the Hanriot division of the Société Nationale de Constructions Aéronautiques du Centre (SNCAC) produced the **NC-510 T3** which flew for the first time in June 1938. The

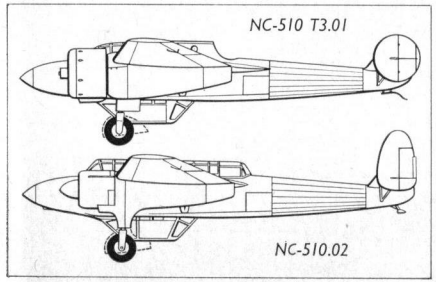


(*Left*) *The NC-510 T3 No.01, and* (*below*) *the NC-510 No.02*

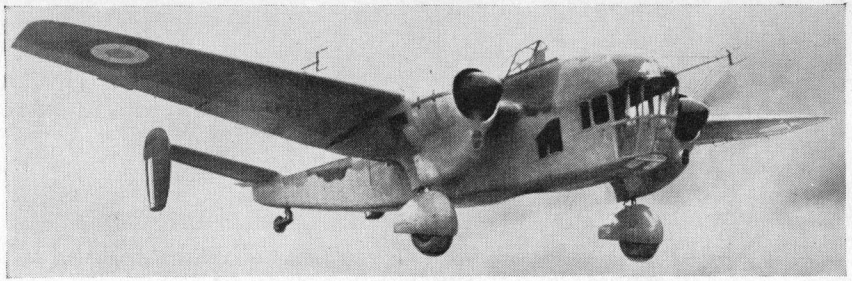


The NC–530 Expérience photographed after initial modifications to the tail assembly. This aircraft was basically an aerodynamic test-bed

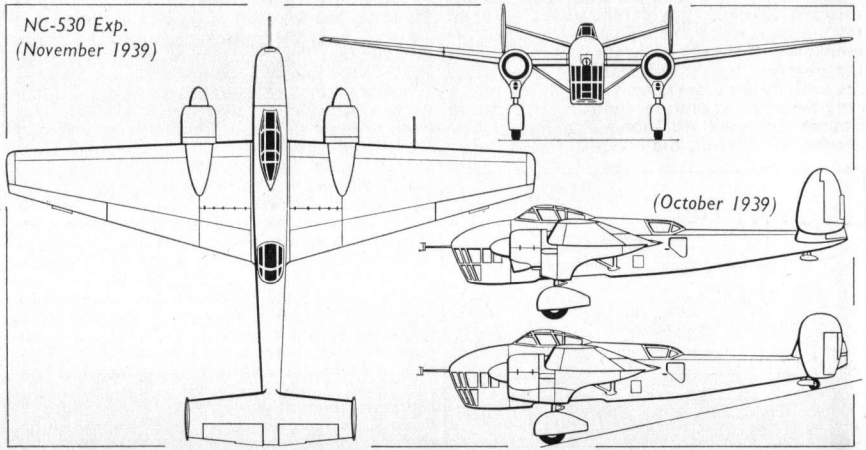
NC-510 was a shoulder-wing twin-engined monoplane housing the observer in an extensively glazed gondola slung beneath the forward fuselage, but within weeks of flight tests commencing, the STAé had reached the conclusion that such an arrangement rendered the observer highly vulnerable to small arms fire and, at the same time, resulted in a major drag penalty. Therefore, the SNCAC team at Bourges initiated work on a completely new *Triplace de Travail*, the NC-530, which, other than sharing an overall similarity of concept, bore no relationship to its predecessor.

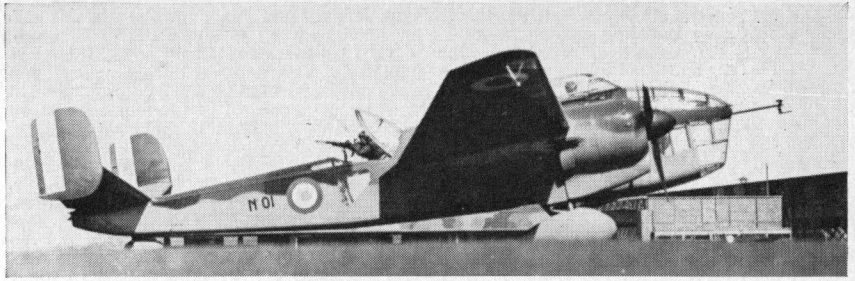


Flown for the first time on June 29, 1939 at Bourges, the first test aircraft was designated **NC-530 Exp**, the suffix indicating *Expérience* and the fact that the machine was considered more in the nature of an aerodynamic test-bed to evaluate the basic configuration rather than as a prototype. Between the seventh and eighth flights tailplane dihedral was increased from 7° to 12°, various tailplane settings were tested, and for the 25th flight, which took place on August 11th, the ailerons were enlarged. On August 25, 1939, the NC-530 Exp was flown from Bourges to Toussus-le-Noble, and, on September 5th, the aircraft started official trials with *Centre d'Essais du Matériel Aérien* personnel at Orléans-Bricy. Six weeks later, on October 17th, the NC-530 Exp returned to Bourges for modifications to the engine cowlings and oil coolant radiators, for an enlarged tailplane with horn-balanced elevators to be fitted, and to have the rudders modified. As tail flutter was still experienced, tailplane dihedral was again increased and the vertical surfaces enlarged and modifications to the flaps and tail surfaces continued through-

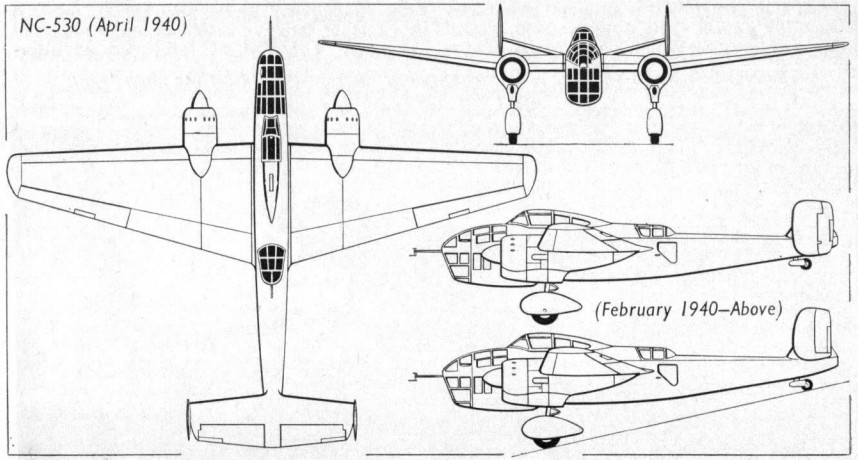


The NC–530 Expérience photographed on November 21, 1939 with ultimate fins and engine cowlings but prior to the elevator and flap modifications





The NC–530 No.01 photographed at Bourges on April 23, 1940 and seen with the ultimate tail assembly fitted from the 14th flight



out the test programme in an effort to achieve really satisfactory handling characteristics.

Meanwhile, a definitive prototype, the **NC-530 No. 01**, had been under construction at Bourges, this commencing its flight test programme on December 29, 1939. Whereas the outer panels of the two-spar wing of the NC-530 Exp had been fabric covered, those of the NC-530 No. 01 were covered by light alloy, and the inclined V-struts that had braced the centre section of the wing to the fuselage mainframe were eliminated as it had been ascertained that these had been partly responsible for the tail flutter experienced during the early part of the testing of the NC-530 Exp. The fuselage of the NC-530 No. 01 was of similar rectangular cross section to that of its predecessor, but the nose was more extensively glazed. The structure was all-metal covered by light alloy panels. The observer was housed in the extreme nose with a SARAM 3.10 short-wave R/T set and dual controls. He was also provided with an aft-firing flexible 7.5-mm. MAC 1934 machine gun on a SAMM-AB54 mounting. A fixed forward-firing machine gun was aimed and fired by the pilot, and a third weapon was provided in the rear cockpit on an Alkan 32H mounting. The wing centre section accommodated two 76 Imp. gal. fuel tanks, a 22 Imp. gal. tank was installed in each engine nacelle, and two 40 Imp. gal. tanks were installed above the bomb-bay which, itself, could accommodate either a 143 Imp. gal. auxiliary tank and an F300, F500 or F700 swivelling camera, or 10 110-lb. bombs.

The NC-530 No. 01 soon proved to suffer in some measure from the tail flutter that had manifested itself from the outset of the NC-530 Exp test programme, and accompanied by some inadequacy of lateral control, resulted in a further series of modifications to the tail assembly. The SNCAC proposed an alter-

The NC–530 No.01 with the penultimate tail arrangement fitted for the ninth flight on February, 13 1940

Testing the of NC–530 No.01 (seen above with penultimate tail arrangement) continued at Bourges until May 1940

native version of the basic design in which the Gnôme-Rhône 14M 6/7 engines would have been supplanted by 450 h.p. Renault 12R air-cooled inline inverted engines, and a retractable undercarriage introduced, this model being designated **NC-531**, but a rather more advanced development was to have been the **NC-532.** The structure of the basic NC-530 design was extremely sturdy, and it was anticipated that it could accept engines of almost twice the power of those initially proposed. Therefore, the NC-532, on which the overall wing span was to be increased from 42 ft. 11 in. to 44 ft. 6⅜ in., was projected with a pair of 1,070 h.p. Gnôme-Rhône 14N 48/49 air-cooled radial engines. In the event, neither NC-531 or -532 was built, and the NC-530 itself, although undoubtedly a sound design, had little chance of a quantity production order in view of the decision to standardize on the Potez 63.11 for the *Groupes Aériens d'Observation.* Testing of the NC-530 No. 01 continued until May 1940 at Bourges, and this prototype was destroyed during the following month at Clermont-Ferrand-Aulnat while being evacuated to the south.

HANRIOT NC-530.01 SPECIFICATION

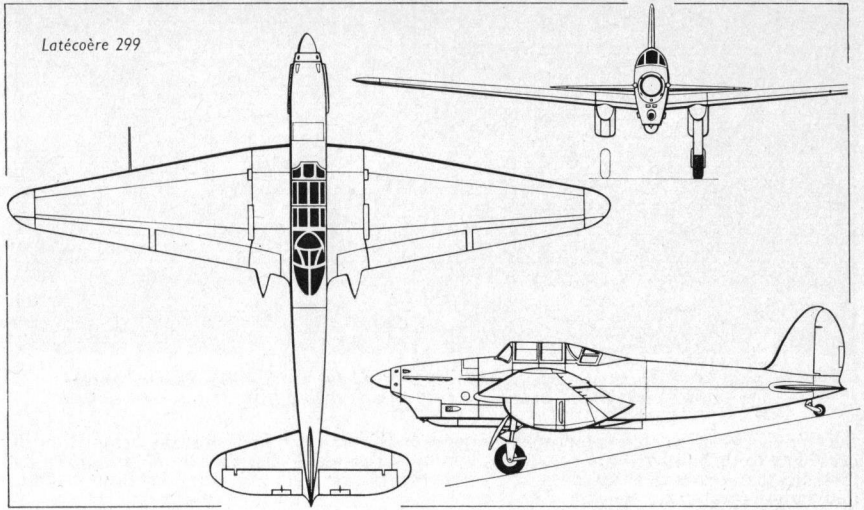
Type: *Three-seat Army Co-operation and Tactical Reconnaissance Aircraft.* **Power Plants:** *Two Gnôme-Rhône 14M 6/7 14-cylinder radial air-cooled engines each rated at* 700 *h.p. for take-off and* 660 *h.p. at* 13,200 *ft.* **Armament:** *One fixed forward-firing* 7.5-*mm. MAC* 1934 *machine gun with* 300 *rounds, one* 7.5-*mm. MAC* 1934 *machine gun on flexible mounting with* 800 *rounds firing from dorsal position, and one* 7.5-*mm. MAC* 1934 *machine gun on flexible mounting with* 500 *rounds firing from forward ventral position, plus* 10 110-*lb. bombs.* **Performance:** *Maximum speed,* 255 *m.p.h. at* 16,900 *ft.; economical cruising speed,* 199 *m.p.h. at* 16,400 *ft.; normal range,* 1,118 *mls.; climb to* 9,840 *ft.,* 5 *min.; service ceiling,* 27,890 *ft.* **Weights:** *Empty,* 7,826 *lb.; normal loaded,* 10,097 *lb,; maximum loaded,* 11,244 *lb.* **Dimensions:** *Span,* 42 *ft.* 11 *in.; length,* 37 *ft.* 3½ *in.; wing area,* 339.06 *sq. ft.*

LATÉCOÈRE 299 — FRANCE

The extreme sturdiness and exceptional handling characteristics displayed by the Latécoère 298 twin-float torpedo-bombing and reconnaissance seaplane resulted, not surprisingly, in consideration being given by the Société Industrielle d'Aviation Latécoère to the development of a version with a wheel undercarriage for shore-based or shipboard operation. The *Service Technique de l'Aéronautique* had already initiated *Programme Technique* A47 intended to provide a replacement for the obsolete Levasseur PL 7 and 101 biplanes, but despite the fact that it did not conform with the requirements of A47, the Latécoère concern evolved the Laté 299, a variant of the Laté 298 with a wheel undercarriage, as a private venture, tendering it to the *Ministère de la Marine*. Offering the major economy of using an essentially similar airframe to that of the Laté 298, the Laté 299 immediately found official favour and, on July 5, 1938, two prototypes were ordered.

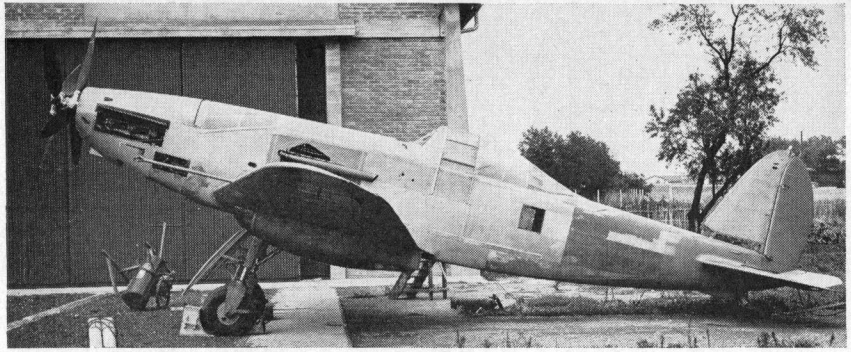
The prototype contract stipulated the use of as many components of the floatplane as practicable, and construction of the **Laté 299** began immediately at Toulouse. The fuselage of the Laté 298B was retained virtually unchanged, the only modification being the introduction of a supplementary frame ahead of the pilot's cockpit resulting in a 1 ft. 8 in. increase in overall length and providing space for a flotation compartment. Some structural

The Laté 299 No.01 (below) was flown for the first time on July 7, 1939, and an initial production batch of 25 aircraft was ordered



reinforcement was necessary to absorb arrester-hook strain, but the rectangular fuselage structure was otherwise identical to that of the Laté 298, comprising four dural longerons, frames and stringers and a stressed vedal skin. The cockpit canopy, engine bearers, integral wing centre section, vertical tail fin and horizontal tail surfaces remained unchanged, but the chord of the rudder was increased, and the replacement of the floats by wheels necessitated the introduction of increased leading-edge sweep on the wing outer panels for c.g. reasons. The semi-retractable radiators housed between the wing centre-section spars of the floatplane were transferred to fairings introduced to house the aft-retracting mainwheels, a radiator being mounted on each side of the wheel legs, the space between the centre section spars being occupied by fuel tanks.

Initial plans called for the installation of an Hispano-Suiza 12Y 27 engine rated at 920 h.p. at 2,590 ft., but in the event an HS 12Y 43 was installed, this offering 970 h.p. at 3,610 ft., and driving a three-bladed HS-Hamilton airscrew. Proposed armament comprised a single 7.5-mm. Darne machine gun in each outer wing panel and aimed by the pilot with the aid of an OPL 38 gunsight, and a similar weapon on a flexible Blanchet-Pilain-60 mounting in



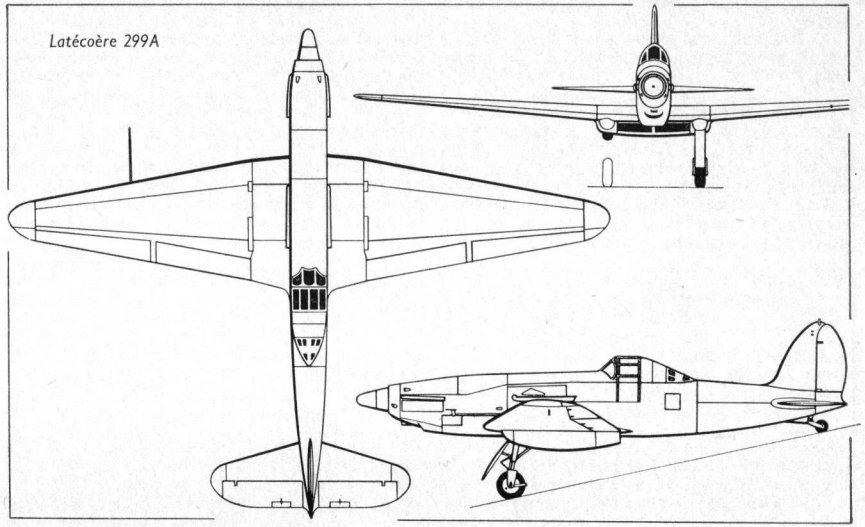
The Laté 299A No.01 was employed as a test-bed for the tandem-mounted engine arrangement and is seen at Toulouse in 1943 shortly before flight testing commenced

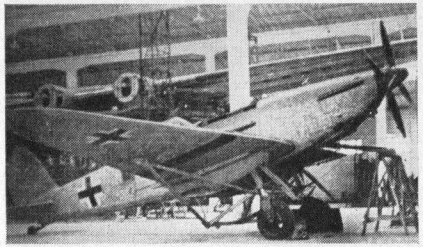
the rear cockpit. The crew complement varied according to the mission. For scouting it was intended that a crew of three (pilot, navigator and radio-operator/gunner), an F30 camera, four 165-lb. bombs and fuel sufficient for a range of 620 miles would be carried; for the torpedo-dropping role, no navigator was to be carried, fuel would be sufficient for a range of 404 miles and a single 1,653-lb. torpedo would be carried semi-externally; for the level bombing mission either two or three crew members could be carried, together with fuel for 404 miles and an offensive load of a single 992-lb. Type P bomb, two 496-lb. Type K bombs, or four 330-lb. Type I2 bombs, and for the patrol task three crew members were intended to be carried, and an auxiliary fuel tank was to provide sufficient fuel for a range of 932 miles.

The **Laté 299 No. 01** was assembled at Cazaux where it was flown for the first time on July 7, 1939, and after the completion of manufacturer's tests the aircraft was flown on September 12th to the Lanvéoc-Poulmic *Aéronavale* base for utilization trials. A number of simulated deck landings were performed before, on September 29th, the Laté 299 No. 01 was flown to Biarritz-Parme. Shortly afterwards, it was joined at Biarritz-Parme by the **Laté 299 No. 02** which flew at this airfield for the first time on October 8, 1939 after being assembled at the nearby Breguet plant of Bayonne-Anglet, the Breguet and Latécoère concerns having merged in January 1939. This second prototype was flown to Saint Raphaël where, after a series of manufacturer's tests, it was handed over to the Naval Air Test Centre on November 21st. By this time, an initial production batch of 25 Laté 299s had been ordered by the *Ministère de l'Air* on behalf of the *Ministère de la Marine*, although none of these was to be completed by June 1940 when further work was abandoned.

The Laté 299 No. 02 underwent various trials at Saint Raphaël, among which were included in May 1940 tests with airscrews of various diameters and with ejector exhausts giving a measure of thrust augmentation, but subsequently both prototypes were placed in storage at Toulouse-Montaudran, remaining there until, in 1941, it was decided to utilize the Laté 299 No. 01 as a flying test-bed.

Ingénieur-Général M. Vernisse, the director of the Arsenal de l'Aéronautique at Villacoublay, had been engaged since 1938 in studies of tandem-mounted liquid-cooled engines driving contra-rotating airscrews via concentric shafts with the aid of special constant-torque couplings of Vernisse's own design, the aim being to gain the advantages of a twin-engine arrangement while restricting the frontal area to that of a single engine. At the time of the Armistice in June 1940, when the Arsenal de l'Aéronautique was evacuated from Villacoublay to Villeurbanne, on the outskirts of Lyons, where it was renamed the Atelier d'Etudes Aéronautiques, *Général* Vernisse was working on a single-seat fighter, the VB 10





(Left) The Laté 299A No.01 undergoing final static tests at Toulouse before initial flight trials and subsequent ferrying to the Luftwaffe base at Bron where it was eventually destroyed in an Allied attack

No. 01, which embodied this radical engine arrangement, construction actually starting in 1943 when the prototype was referred to as a "world speed record contender". In the meantime, however, *Général* Vernisse was anxious to obtain some flight experience with the power plant arrangement, and therefore the Latécoère plant at Toulouse rebuilt the entire forward fuselage of the Laté 299 No. 01 so that it could house a tandem-mounted pair of Hispano-Suiza 12Y 31 engines which, each developing 830 h.p. for take-off and 860 h.p. at 10,660 ft., drove two three-bladed Ratier contrarotating airscrews via concentric shafts. The pilot was repositioned just aft of the wing trailing edge, and a "buried" cockpit was provided for a flight test engineer aft and below the pilot. Radiators were mounted beneath the wing centre section, between the redesigned, shallower mainwheel fairings, and the modified aircraft was designated **Laté 299A No. 01**.

After the *Wehrmacht* entry into the Unoccupied Zone in November 1942, work on the modification of the Laté 299A was allowed to continue, and flown in 1943, the aircraft was ferried to the *Luftwaffe* base at Bron, near the Atelier d'Etudes Aéronautiques facility, where the test programme continued, proving the basic concept before, on April 30, 1944, an Allied attack on the Bron *Luftwaffe* base resulted in the destruction of the Laté 299A test-bed.

LATÉCOÈRE 299 SPECIFICATION

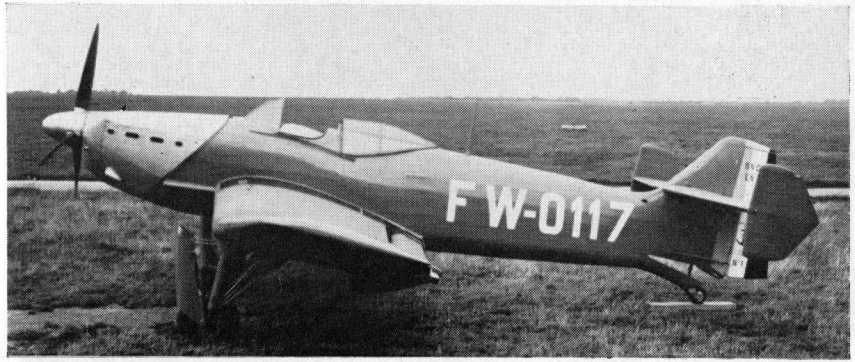
Type: *Two/three-seat Shipboard Reconnaissance-Bomber and Torpedo Aircraft.* **Power Plant:** *One Hispano-Suiza* 12*Y* 43 12*-cylinder Vee liquid-cooled engine rated at* 970 *h.p.* **Armament:** *Two fixed forward-firing* 7.5*-mm. Darne machine guns in wings with* 300 *r.p.g., one* 7.5*-mm. Darne machine gun with* 500 *rounds on flexible mounting in rear cockpit, and one* 1,653*-lb. torpedo, one* 992*-lb. Type P bomb, two* 496*-lb. Type K bombs, or four* 330*-lb. Type* 12 *bombs.* **Performance:** *Maximum speed (with* 1,320*-lb. bomb load),* 221 *m.p.h. at* 4,920 *ft.; economical cruising speed,* 149 *m.p.h.; range (with* 1,653*-lb. torpedo),* 404 *mls., (with auxiliary ventral tank),* 932 *mls.; climb to* 13,120 *ft. (with* 1,320*-lb. bomb load),* 10 *min.* 43 *sec.; service ceiling (at maximum loaded weight),* 19,685 *ft.* **Weights:** *Empty,* 6,989 *lb.; maximum loaded,* 10,251 *lb.* **Dimensions:** *Span,* 51 *ft.* 3¾ *in.; length,* 40 *ft.* 3½ *in.; height,* 14 *ft.* 11 *in.; wing area,* 372.43 *sq. ft.*

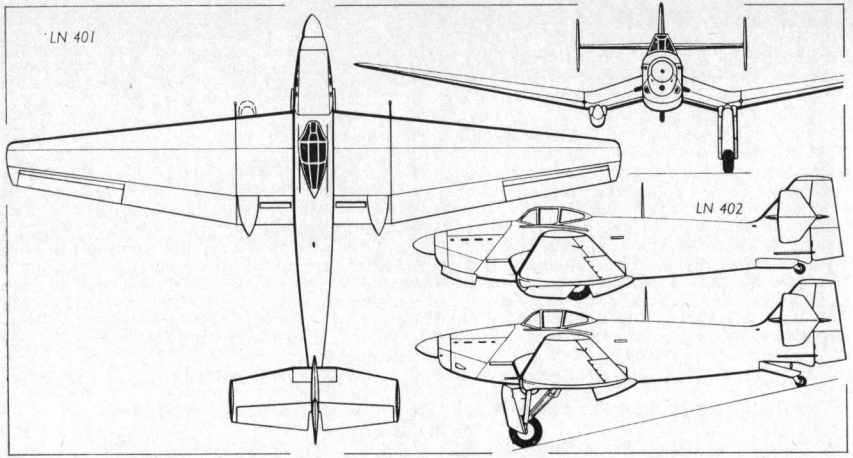
Although the Second World War was to disprove the value of the specialized dive-bomber except in circumstances in which virtually no aerial opposition was to be encountered, world interest in this weapon had been aroused in the late 'twenties with the appearance of the Junkers K.47 and grew to the extent that, by the mid 'thirties, aircraft intended solely for the dive-bombing role were under development in every major aircraft-manufacturing country.

In France, the Société Anonyme Loire-Nieuport which, in 1936, was to be nationalised as the Société Nationale de Constructions Aéronautiques de l'Ouest (SNCAO), had begun to evince interest in the potentialities of dive-bombers in 1932 and, under the leadership of M. Pillon, the Nieuport design team at Issy Les-Moulineaux had completed work on a tandem two-seat dive-bomber, the **Ni-140**, late in 1934. Intended for shipboard operation, the first of two prototypes, the Ni-140 No. 01, was flown in March 1935, and its concept was remarkably similar to that of the Junkers Ju 87, construction of the first prototype of which had only just been initiated when flight testing of the French aircraft began. Indeed, *so* similar in general configuration to the Junkers design was this inverted gull monoplane with its fixed "trousered" undercarriage that, more than five years later, M. Pillon was to face charges brought by the German occupation authorities that his work was based on information acquired from the Junkers design office by espionage.

From experience gained with the two proto-

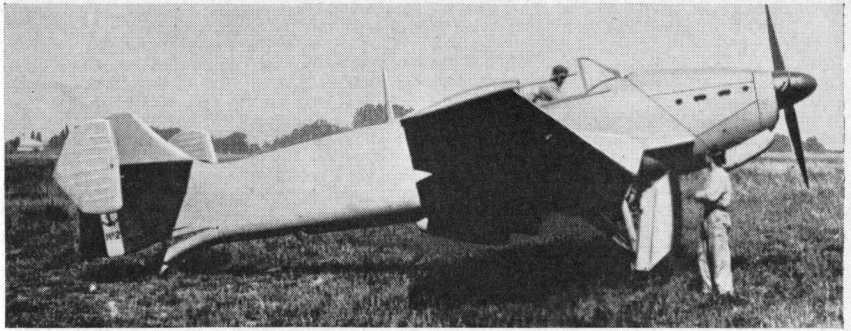
The LN 40 *No.*1 *seen at Villacoublay in* 1938 *after the addition of endplate vertical tail surfaces*



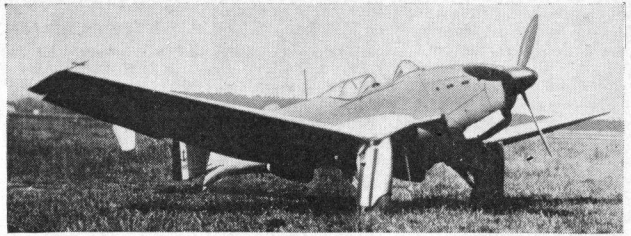


types of the Ni-140, in 1936 Pillon's team initiated the design of a single-seat shipboard dive-bomber with a semi-retractable undercarriage, although no official requirement for such an aircraft existed at that time. Designated **LN 40**, the aircraft retained the inverted gull wing arrangement of its predecessor, this having the dual advantage of shortening the main undercarriage members and positioning wing-fold points sufficiently low to render unnecessary the use of steps by ground per-

The LN 40 *No.*1 (*FW-0117*) *which underwent Aéronavale trials in November* 1938



(*Above and right*) *The first pre-production aircraft, the LN* 40 *No.*2 (*subsequently LN* 401 *No.*2)



sonnel engaged in folding or unfolding the wings. The monocoque fuselage was based on that of the Ni-161 single-seat fighter prototype; all fuel was housed in the wing centre section; the lower half of the rudder was divided vertically so that it opened in two segments at right angles to the centreline to serve as a dive brake; a crutch beneath the fuselage swung forward to ensure that the bomb cleared the airscrew disc when released, and the main undercarriage members retracted rearwards, the wheels remaining semi-exposed when retracted.

The prototype, the **LN 40 No. 1**, commenced its flight trials at Villacoublay in June 1938, with the SNCAO chief test pilot, Pierre Nadot, at the controls. Tests revealed the need for additional vertical tail surface area, and auxiliary endplate fins were added to the tailplane for the official trials which began at the *Centre d'Essais du Matériel Aérien* (CEMA) at Villacoublay in September 1938. Further trials were undertaken at the naval test centre

at Saint Raphaël in November, but prior to these the SNCAO test pilot Habert had completed a series of 10 hooked landings and 15 dives from various altitudes. During the course of the latter the split rudder-type dive brake had proved ineffective, this feature being subsequently deleted and supplanted by undercarriage extension as a means of braking.

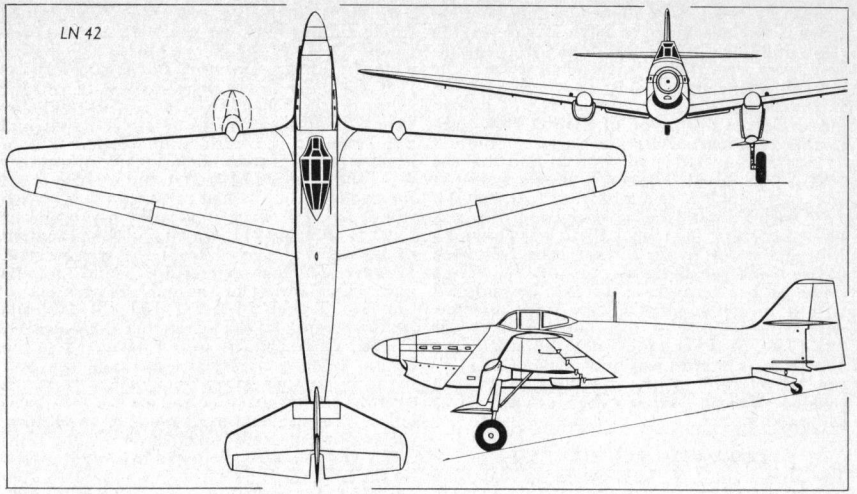
In the meantime, in 1937, six additional LN 40s had been ordered by the *Ministère de l'Air* for the Navy. These differed little from the prototype externally, although some minor structural changes were introduced, such as the use of drop forgings in place of riveted joints. The Hispano-Suiza 12Xcrs 12-cylinder liquid-cooled engine rated at 670 h.p. for take-off and 690 h.p. at 13,120 ft. was retained for the production model, the outer panels of the two-spar all-metal wing swivelled on the rear spar to fold aft, and an arrester hook was incorporated in the semi-retractable tailwheel unit. A further order for 36 aircraft was placed on behalf of the Navy by the *Ministère de l'Air* and confirmed on July 3, 1939, by which time the designation **LN 401** had been applied to the production model. Simultaneously, a further 40 had been ordered for the *Armée de l'Air*, the French Air Staff having been impressed by the effect of dive-bombers in Spain. The version for the *Armée de l'Air*, which received the designation **LN 411**, was essentially similar to the LN 401 for the *Aéronavale*, apart from the deletion of the wing folding, the Lux inflatable flotation bags, and the arrester hook, and production of wings, tail assemblies, engine mounts and cowlings was undertaken by the SNCAO's Saint Nazaire plant, the Issy-Les Moulineaux works manufacturing the fuselages.

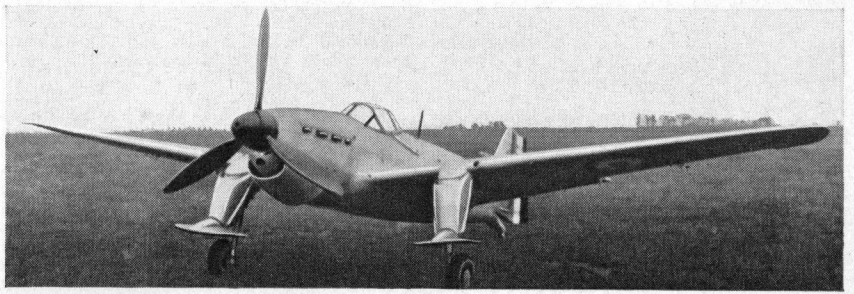
The first pre-production LN 401s came off the line in the late spring of 1939, and after official trials four of these were handed over to *Escadrille* AC 1 of the *Aéronavale*, this unit operating these alongside 12 Dewoitine D.373 for training purposes until early 1940 when AC 1 converted to the Potez 631, but by October 1939 the *Armée de l'Air* was already disenchanted with the potentialities of the LN 411, and on the 3rd of that month concluded arrangements to hand over all but one of the LN 411s under construction to the *Aéronavale*. The *Armée de l'Air* had concluded that the LN 411 was too slow and unwieldy for successful operation under the conditions that the service envisaged. Capable of delivering an appreciably smaller load than the contemporary Ju 87B and possessing a performance barely superior to that of the German dive-bomber, the LN 411 would have been the natural prey of fighters and highly vulnerable to determined ground fire, a prognosis that was to be borne out in May 1940.

EXPERIMENTAL VARIANTS

In an attempt to rectify the shortcoming in the performance of the LN 401, an airframe was fitted with an Hispano-Suiza 12Y-31 rated at 830 h.p. for take-off and 860 h.p. at 10,660 ft., this experimental version being designated **LN 402** and flown for the first time late in 1939. However, further development was abandoned in favour of a more extensively redesigned model, the **LN 42**, which began life as the one LN 411 not passed over to the *Aéronavale*. The LN 42 retained the fuselage of the LN 411 which was married to a completely redesigned wing of reduced span (42 ft. 7⅜ in.) and gross area (226 sq. ft.), and an Hispano-Suiza 12Y-51 engine rated at 1,100 h.p. for take-off and offering similar power at 10,695 ft. The wing featured continuous dihedral from root to tip, the horizontal tail surfaces were redesigned and enlarged, and the endplate vertical surfaces were eliminated.

The LN 42 prototype was nearing com-





pletion at Issy-Les Moulineaux in June 1940 when it was evacuated to Istres where taxying trials and one or two short hops from the runway were reportedly undertaken before the aircraft was transported to a farm at Flayosc, in the Draguignan area, where it was hidden alongside the prototype of the SO 30N commercial transport. After the liberation the LN 42 was recovered and transported to the SNCAC plant at Toussus-le-Noble where it was re-assembled, being flown on August 24, 1945 with Fernand Lasne at the controls. On November 9, 1945, the LN 42 was flown to Marignane for trials, further tests following at Hyères before, in the summer of 1946, it was flown back to Toussus-le-Noble to be equipped with a reversible-pitch Escher-Wyss airscrew with which flights were resumed on October 28, 1946. Further trials were conducted in 1947, but as interest was now being evinced by the *Aéronavale* in the possibilities of gas turbine-powered types the aircraft was scrapped.

OPERATIONAL CAREER

The first 16 LN 401s were undergoing acceptance trials in November 1939, and were subsequently issued to *Escadrilles* AB 2 and AB 4. As France's sole aircraft carrier, the *Béarn*, was engaged in the task of transporting to France aircraft purchased in the U.S.A., the LN 401s were never involved in shipboard operations. In April 1940, AB 4 relinquished its LN 401s and re-equipped with LN 411s, its earlier equipment being distributed between a conversion unit at Lanvéoc-Poulmic and the war reserve at Cherbourg. By May 10th, AB 2 and AB 4, with 12 LN 401s and 12 LN 411s, were based at Berck and Cherbourg-Querqueville respectively. AB 2 had already undertaken sorties with its LN 401s over the Walcheren and Beveland islands when it was joined at Berck on May 17th by the LN 411s of AB 4. Two days later, the two *Escadrilles* joined forces in an attack on the Berlaimont crossroads, but 10 of the 20 machines participating were shot down, and none of the 10 survivors that regained Berck was airworthy on the following day when the Origny Bridge over the Oise was attacked by three aircraft that had not flown on the Berlaimont sortie. One of these was lost during the attack, and another was shot down on May 21st, but by May 22nd the decimated units had regained some operational strength, each possessing a mixture of five LN 401s and 411s which had been repaired or hurriedly delivered from the war reserve. However, further operations could not be undertaken owing to the capture of most of the ground staff of AB 2 and AB 4 in the Boulogne area by the advancing *Wehrmacht*.

The two *Escadrilles* were transferred to the South, landing at Hyères on June 4th and flying a number of reconnaissance missions over the Italian coastline and, on the 14th, providing French naval units engaged in shelling the Genoa area with top cover. On June 18th, AB 2 and AB 4 participated in a night attack on the Imperia Harbour, and on the 25th, two days after the French government capitulated, the two units flew to North Africa, landing at Bône where, on August 1, 1940, they were redesignated 2AB and 4AB and subsequently converted to Martin 167 bombers.

Orders placed for the LN 401 and 411 prior to May 29, 1940 totalled 152 aircraft, although it is unlikely that half of these had been built when, on June 14th, production terminated with the German occupation of Paris. All 15 surviving LN 401s and 411s in the possession of the *Aéronavale* on August 15, 1940, were disassembled and placed in storage. Early in 1941, the SNCAO was absorbed by the Société Nationale de Constructions Aéronautiques de Sud-Ouest (SNCASO), and the Châteauroux plant of this concern assembled

24 LN 401s and LN 411s from components recovered from the occupied zone with the authorization of the Germans, this task being completed in March 1942, and the aircraft being flown to Hyères. No Vichy-controlled unit re-equipped with these dive-bombers, and as only 12 were seized by the German forces when the Vichy zone was occupied in November 1942, it may be assumed that the remaining 12 had been flown to North Africa where they joined the previously-listed aircraft that had been held in storage at Bizerte-Karouba since August 1940. All the LN 401s and 411s at Bizerte-Karouba were destroyed in the Allied attacks that followed the German landing at this base in 1942.

LOIRE-NIEUPORT LN401–411 SPECIFICATION

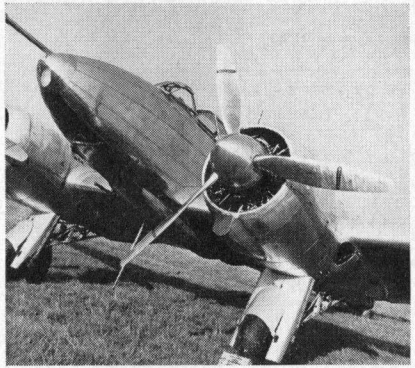
Type: *Single-seat* (*LN* 401) *Shipboard or* (*LN* 411) *Land-based Dive-bomber*. **Power Plant:** *one Hispano-Suiza* 12*Xcrs* 12*-cylinder Vee liquid-cooled engine rated at* 670 *h.p. for take-off and* 690 *h.p. at* 13,120 *ft*. **Armament:** *One engine-mounted* 20*-mm. Hispano-Suiza cannon and two wing-mounted* 7.5*-mm. Darne machine guns with* 600 *r.p.g., plus one* 496*-lb. BEA* 1938 *or* 331*-lb.* 12 *bomb, or* 10 22*-lb. or* 33*-lb. bombs*. **Performance:** (*Applicable to both LN* 401 *and* 411) *Maximum speed*, 199 *m.p.h. at sea level*, 236 *m.p.h. at* 13,120 *ft.; maximum cruising speed*, 211 *m.p.h. at* 13,120 *ft.; economical cruising speed*, 186 *m.p.h.; maximum range*, 746 *mls.; ceiling*, 31,168 *ft*. **Weights:** (*LN* 401) *Empty*, 4,945 *lb.; normal loaded*, 6,250 *lb*. **Dimensions:** *Span*, 45 *ft*. 11 *in.; length*, 31 *ft*. 11¾ *in.; height*, 11 *ft*. 5¾ *in.; wing area*, 266.4 *sq. ft*.

POTEZ 63 SERIES — FRANCE

There can be no denying that the strategic fighter concept was far-sighted, but it is equally undeniable that its fulfilment was extremely difficult. No more arduous a task could have been set a combat aircraft designer than that of evolving a long-range multi-seat fighter capable of escorting bombers, deep penetrations of enemy territory, standing patrols and, for good measure, day and night interception. The desired range could only be obtained at the expense of manoeuvrability, and manoeuvrability was a vital quality if the strategic fighter was to combat effectively the more specialized defensive fighter by which it would be opposed. Such an aircraft *had* to be a compromise, and compromises are rarely good enough. Certainly no entirely satisfactory strategic fighter emerged from the 'thirties, but at the time of its début in 1936, the Potez 63 appeared to come as close to fulfilling strategic fighter requirements as any aircraft conceived at that time.

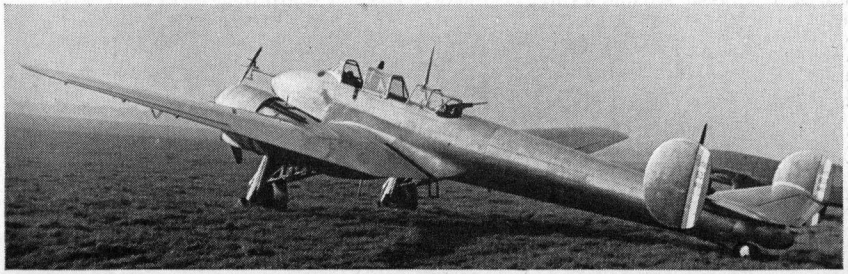
The Potez 63 was widely considered to be a trend setter, and some Frenchmen were subsequently to claim that it provided the inspiration for the Messerschmitt Bf 110. It is true that both French and German aircraft were slim, rakish, twin-engined low-wing cantilever monoplanes of all-metal, flush-riveted, stressed-skin construction, with retractable undercarriages and twin fins and rudders, but the claim had no foundation in fact as design development of both Potez 63 and Bf 110 had begun virtually simultaneously at Méaulte and Augsburg respectively, the prototypes making their initial flights within 18 days of each other.

The Potez 63 was designed by Messrs Coroller and Delaruelle to meet the requirements of a specification issued in October 1934 by the *Service Technique de l'Aéronautique* which called for a C3 (*Triplace de Chasse* or Three-seat Fighter) aircraft, and competed for orders with the Hanriot 220, the Loire-Nieuport 20, the Romano 110, and the Breguet 690. The specification called for a twin-engined aircraft designed around the new Hispano-Suiza and Gnôme-Rhône air-cooled radial engines of small diameter. Fixed forward-firing armament had to include a 20-mm. cannon, and sufficient radio equipment had to be carried to enable the aircraft to act as controller for single-seat fighter formations.



Work on the **Potez 63 No. 01** began at Méaulte in April 1935, and almost exactly one year later, on April 25, 1936, the prototype was flown for the first time. For initial trials, the Potez 63 No. 01 was fitted with a provisional braced wooden tail assembly suitable for the testing of fins and rudders of various shapes and sizes, and flight testing proceeded satisfactorily until May 6th when the port engine shed an airscrew blade. The engine promptly tore itself from its mount and hung suspended beneath the wing from two flexible connections.

(*Above left and below*) *The Potez* 63 *No.*01 *after the introduction of the definitive tail surfaces. The glazed panel beneath the extreme nose was later deleted*

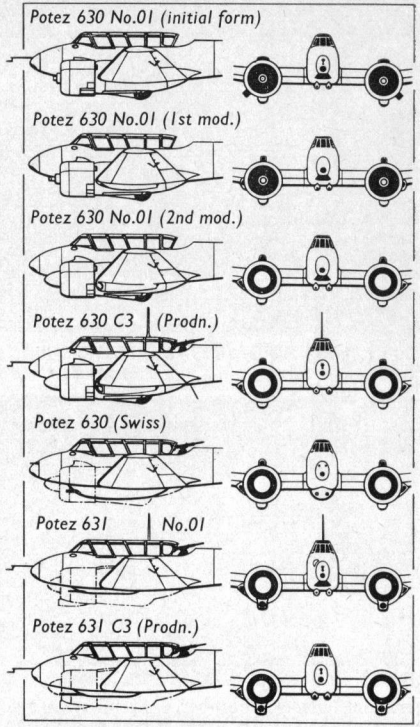


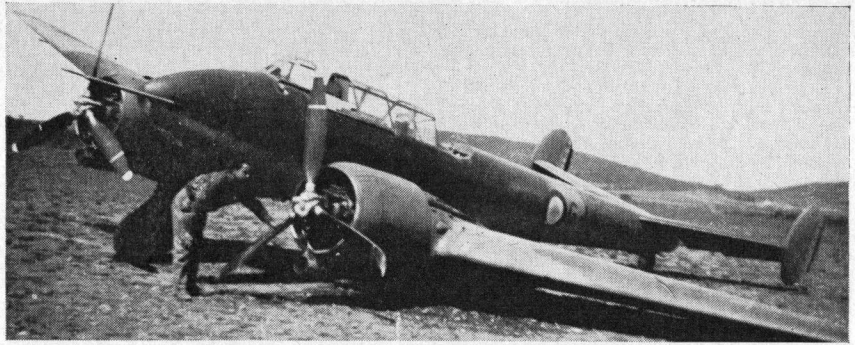
The pilot, Nicolle, succeeded in retaining control, eventually managing to jettison the dead engine and land without further damaging the aircraft.

After repairs, flight testing was resumed at Méaulte and, on August 3, 1936, the aircraft was ferried to Villacoublay, returning to Méaulte on the 31st of the month to receive its definitive metal tail assembly. Simultaneously, a new undercarriage with longer-stroke shock-absorber struts was fitted, the aircraft returning to Villacoublay on November 20th, and commencing its official CEMA (*Centre d'Essais du Matériel Aérien*) trials during the following month. These were suspended briefly during January 1937 to enable modifications to be made to the 580 h.p. Hispano-Suiza 14Hbs engines, the undercarriage and the tail assembly, but were completed during the early spring, revealing only minor defects, such as the need to improve control balance and low-speed longitudinal stability.

The original C3 requirement had specified the Hispano-Suiza 14 and the Gnôme-Rhône 14 Mars as alternative power plants, and, accordingly, a second prototype fitted with the latter engine had been built, and had flown at Méaulte on March 15, 1937 with test pilot Georges Détré at the controls. This received the designation **Potez 631 C3 No. 01** and thus the Hispano-Suiza-engined prototype became the **Potez 630 C3 No. 01.**

In May 1937, by which time Messers Coroller and Delaruelle had presented proposals for several derivatives of the basic Potez 63 design, a contract was received from the *Ministère de l'Air* calling for 10 prototype and evaluation aircraft which were to include those already flying. This contract comprised four Potez 630s (three three-seat fighters and one two-seat night fighter), three Potez 631s (two three-seat fighters and one dual-control conversion trainer), one **Potez 633** two-seat light bomber, one **Potez 637** three-seat army co-operation and reconnaissance aircraft, and one **Potez 639**


Potez 630 No.01 (initial form)
Potez 630 No.01 (1st mod.)
Potez 630 No.01 (2nd mod.)
Potez 630 C3 (Prodn.)
Potez 630 (Swiss)
Potez 631 No.01
Potez 631 C3 (Prodn.)



(*Above*) *A Potez* 633 *Grec* (*G* 16) *utilized by the Armée de l'Air, and* (*below*) *a Potez* 633 *of the* 31*a Mira Vomvardismou*

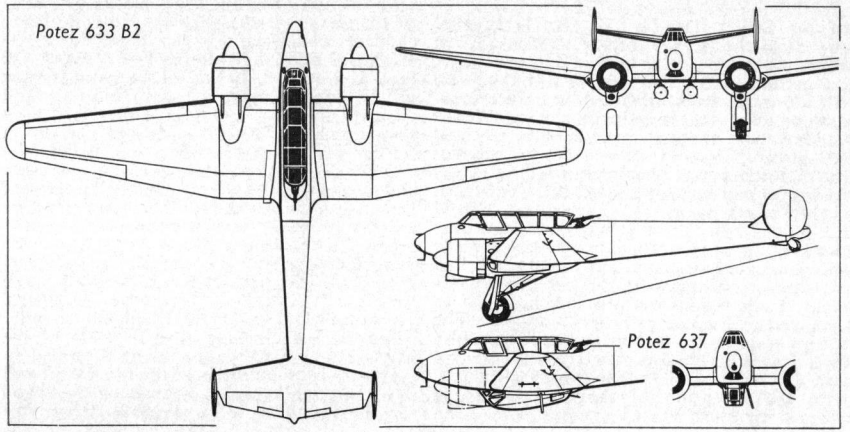
two-seat attack bomber. Simultaneously, preparations for the series production of the Potez 63 were initiated at Méaulte.

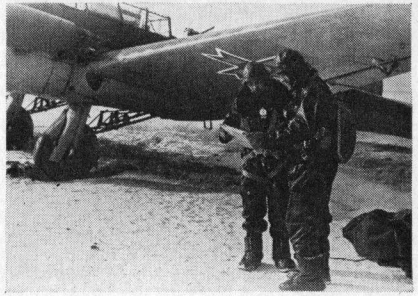
In the following month the Méaulte facilities, together with those of the C.A.M.S. and Mureaux concerns, and part of those of the Amiot and Breguet companies, were nationalised as the Société Nationale de Constructions Aéronautiques du Nord (SNCAN). The new organisation was promptly awarded two production contracts, the first of these covering 80 Potez 630 C3 fighters (Nos. 3 to 82) powered by Hispano-Suiza 14AB 10/11 engines rated at 700 h.p. for take-off an 725 h.p. at 10,660 ft., and 30 Potez 631 C3 fighters (Nos. 11 to 40) with Gnôme-Rhône 14M 4/5 engines rated at 700 h.p. for take-off and 660 h.p. at 13,200 ft. The second contract covered the production of 10 dual-control **Potez 631 Ins** trainers (Nos. 1 to 10) and a further 50 Potez 631 C3 fighters (Nos. 41 to 90).

POTEZ 633

When, in February 1938, the first production Potez 63, the **Potez 630 C3 No. 1**, flew for the first time, prototypes of both the **Potez 632 B2** and **633 B2** (*Bombardement Biplace*) were already under test. The Potez 632 B2 No. 01 was, in fact, the **Potez 630 CN2** (*Chasse de Nuit Biplace*) No. 2 two-seat night fighter prototype which, retaining its Hispano-Suiza 14AB engines, had been modified as a light bomber and flown in January 1937, but whereas development of the Potez 632 B2 was not persisted with, the essentially similar Gnôme-Rhône-engined Potez 633 B2 found favour with the *Armée de l'Air* for which, in May 1938, 125 examples of the light bomber were ordered.

The shapely Potez 633 light bomber, with its pleasant flying characteristics and easy maintenance—a complete power plant could be changed in 13 minutes—had already attracted the attention of several foreign governments; interest crystallizing in the form of orders from the Rumanian and Greek governments early in 1938 for 20 and 24 aircraft respectively, and the acquisition of a manufacturing licence by the Czechoslovak government. The designation **Potez 636** was allocated to the proposed Czech-built Potez 633, and plans were formulated to produce the bomber at Avia's Letnany plant, the Gnôme-Rhône engines being manufactured by Walter. In the event, preoccupation with production





The crew of a Rumanian Potez 633 prior to taking-off on a mission in support of Rumanian columns in Bessarabia in the autumn of 1941

of the Soviet Tupolev SB (B 71) bomber prevented the licence for the French aircraft being taken up.

The Potez 633 B2 was identical to the Potez 631 C3 apart from armament and accommodation. The glazed panelling beneath the extreme nose featured by the Potez 630 and 631 prototypes and deleted from the production fighter was reinstated; the single fixed forward-firing 7.5-mm. MAC 1934 mounted slightly to starboard in the nose with a bulged fairing enclosing the cartridge drum and featured by some early production Potez 631s was standardised, a similar weapon being mounted in the rear cockpit, and vertical stowage for eight 110-lb. bombs was provided in the space occupied by the navigator in the fighter. The wing comprised a rectangular centre section built integral with the fuselage and tapered two-spar outer panels, the whole structure, with the exception of the ailerons, being covered by flush-riveted stressed skin. The fuselage comprised three sections, the centre section being built up on four longerons to which four separately-built stressed-skin panels were attached, the nose and rear sections being monocoque structures manufactured in halves and joined along the upper and lower centrelines. Pneumatically-operated split flaps were carried by the wing centre section which housed the two 83.5 Imp. gal. fuel tanks, and the hydraulically-operated main undercarriage members were raised aft into the tails of the engine nacelles.

By the summer of 1938, the French Air Staff had begun to revise its ideas as a result of the lessons provided by the conflict in Spain, and although there had been a marked division of opinion concerning the merits of the classic light bomber as compared with those of the specialised attack bomber, opinion had hardened in favour of the latter with the result that the order placed on behalf of the *Armée de l'Air* for the Potez 633 was suddenly cancelled. By this time, Potez 633 B2 Nos. 1 and 2 had already flown; Potez 630 Nos. 1, 2, 3, 8, 9, 10 and 11 were undergoing utilization tests, together with Nos. 01 and 02, at the CEMA; additional orders had been placed with the SNCAN's Méaulte plant for a further 117 **Potez 631 C3s** (Nos. 91 to 207) and for 60 **Potez 637 A3** army co-operation and reconnaissance aircraft, and the number of production manhours required to manufacture a Potez 63 had been reduced to 11,500.

The Rumanian and Greek Potez 633s were dubbed respectively Potez 633 *Roumain* and Potez 633 *Grec*, and the aircraft in each batch were numbered in distinctive sequence. The Potez 633 *Roumain* was fitted with 7.7-mm. FN-Browning machine guns in place of the MAC 1934s, a third gun being mounted in the floor of the gunner's cockpit to fire aft and down through a trap, and provision was made for the mounting of a single F30 or F50

camera in the bomb-bay. Whereas the Potez 633 *Roumain* had electrically-actuated Ratier airscrews and inertia starters, the Potez 633 *Grec* had hydraulic airscrews and hand-turning gear. The Greek aircraft were also fitted with four GPU racks beneath the centre section to carry four 110-lb. bombs, raising total bomb load to 1,320 lb., and a Bronzavia periscopic bomb sight was mounted in the floor of the rear cockpit to enable the radio-operator/gunner to function as a bombardier. Alternatively, the Potez 633 *Grec* could carry a pair of 441-lb. bombs on two of the GPU racks for dive-bombing attack.

The initial contract for 20 aircraft placed with the SNCAN by the Rumanian government had been augmented on April 28, 1938 by an order from the *Ministère de l'Air* for a further 20 aircraft for Rumania, these being referred to as "Potez 63 *Franco–Roumains*", these being, in fact, similar to the Potez 633 *Roumain* but had started down the production line as Potez 633s for the *Armée de l'Air*. Owing to the tension that existed between Rumania and Hungary over the Transylvania problem, and the possibility of hostilities breaking out between the two countries, the Rumanian government was anxious to obtain early delivery, and the first aircraft had, in fact, been ferried to Rumania before the end of 1938, deliveries to Greece not commencing until the spring of 1939. As completed the aircraft were flown from Méaulte to Villacoublay where they received airworthiness certification and temporary civil registration before being ferried to Rumania and Greece by SNCAN pilots.

One of the first aircraft on the Greek order, registered F-ARQP, crashed near Athens on May 31, 1939, killing its SNCAN ferry pilot, but deliveries continued until August when, in view of the international situation, the French Government sequestered the remaining 13 Greek machines awaiting delivery, together with 19 of those on the second Rumanian contract which had been completed at Méaulte that month (10 having been completed in June, four in July and the final six in August). Some 32 Potez 633s were thus acquired by the *Armée de l'Air* which, several months later, was to obtain a further four from a batch intended for China. The Chinese government had placed an order for nine Potez 633s, and four of these, together with 13 Morane-Saulnier 406 fighters, were already aboard ship at the time the French government decided to commandeer all undelivered military aircraft built against foreign contracts. When the aircraft reached Haiphong they were taken over by the French Colonial Administration, assembled and placed in service with an Indo-Chinese-based *Armée de l'Air* unit. These Potez 633s were to see some action in January 1941 when Thai forces invaded French Indo-China.

Meanwhile, the Swiss government had evinced some interest in the Potez 63 to fulfil a *Flugwaffe* requirement for a light bomber and attack aircraft, and had purchased two Potez 630 C3s from the French government, these coming from the original order for 80 aircraft of this type for the *Armée de l'Air*. Modified at Méaulte and referred to as the Potez 63 *Suisse*, the first aircraft was flown to Switzerland on October 22, 1938 for *Flugwaffe* evaluation. After delivery, the two aircraft were each fitted with a pair of 7.45-mm. machine guns in the nose, and a deep ventral tray housing two 20-mm. FFK-HS cannon and their ammunition, but no further examples were ordered. Another Potez 630 was modified for demonstration to the Yugoslav government. Registered F-AREY, this aircraft was demonstrated at Belgrade on April 20, 1939.

By September 3, 1939, the Méaulte plant

POTEZ 633 B2 SPECIFICATION

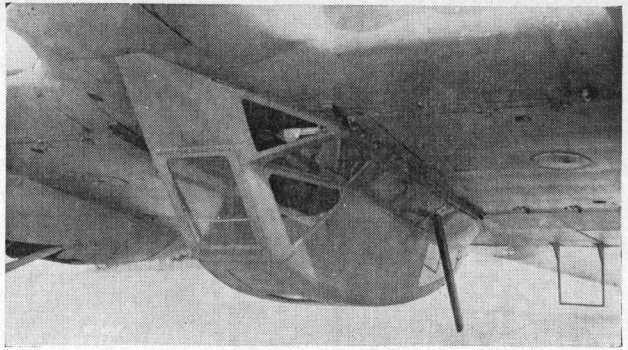
Type: *Two-seat Light Bomber.* **Power Plants:** *Two Gnôme-Rhône 14M 6/7 14-cylinder air-cooled radial engines each rated at 700 h.p. for take-off and 660 h.p. at 13,200 ft.* **Armament:** (*Defensive*) *One fixed forward-firing 7.5-mm. MAC 1934 (or 7.7-mm. FN-Browning) machine gun in fuselage nose and one 7.5-mm. MAC 1934 (or 7.7-mm. FN-Browning) machine gun on flexible mounting in rear cockpit.* (*Offensive*) *Eight 110-lb. bombs internally and (Potez 633 Grec) four 110-lb. bombs externally, or two 441-lb. bombs externally when no internal bomb load carried.* **Performance:** *Maximum speed, 224 m.p.h. at sea level, 273 m.p.h. at 13,780 ft.; maximum cruising speed, 248 m.p.h. at 13,120 ft.; economical cruising speed, 199 m.p.h. at 13,120 ft.; maximum range, 810 mls.; climb to 13,120 ft., 8.5 min.; service ceiling, 26,250 ft.* **Weights:** *Empty, 5,150–6,393 lb.; loaded, 9,204–9,436 lb.* **Dimensions:** *Span, 52 ft. 6 in.; length, 36 ft. 3¾ in.; height, 11 ft. 9¾ in.; wing area, 351.979 sq. ft.*

had completed 80 Potez 630s, 210 Potez 631s and 60 Potez 637s for the *Armée de l'Air*, plus the Potez 633s against export orders, and had turned its assembly line over to the Potez 63.11 for which the SNCAN's Les Mureaux plant was also tooling.

OPERATIONAL CAREER OF THE POTEZ 633

After delivery to the *Armée de l'Air*, the Potez 633s taken over from the Rumanian and Greek contracts were assigned the task of transitional trainers at Salon-de-Provence with the 54e *Escadre* which, previously equipped with Potez 540s and Mureaux 113s, was in process of converting to the more heavily loaded Breguet 691. In December 1939, the 54e *Escadre* was joined by the Bloch 210-equipped 51e *Escadre* to form the 6e *Brigade de Bombardement d'Assaut*, and as more Bre 691s became available, the Potez 633 B2s were progressively passed to the latter *Escadre*. By May 19, 1940, when the unit landed at Etampes to join operations, having, in the meantime, become *Groupement* 19 and comprising GBA 1/51 and II/51, conversion to the Breguet was still incomplete, and Potez 633 B2s were included on the operational strength. When 14 aircraft from GBA I/51 and II/51 undertook their first operational sortie on May 20th with a strafing attack against *Wehrmacht* columns in the vicinity of Arras, three Potez 633 B2s were flown by pilots from the latter *Groupe*. This was destined, however, to be the only recorded operation in Europe in which the Potez 633 participated in French colours, and two days later the type was withdrawn from first-line service.

When Italian forces invaded Greece in October 1940, the 31st Bomber Squadron (31*a Mira Vomvardismou*) of the Royal Hellenic Air Force had nine Potez 633s on strength, and in concert with the Blenheims of the 32nd Squadron and the Battles of the 33rd Squadron, these were immediately engaged in attacks on Italian supply lines in Albania, the airfields of Corytsa and Agyrocastro, and Italian troop concentrations, but shortages of spares and inadequate maintenance facilities took greater toll of the Potez 633s than did the *Regia Aeronautica*, and the 31st was soon reduced to three airworthy aircraft whose activities were finally terminated by lack of oil and fuel.



The observation gondola of the Potez 637 A3 tactical reconnaissance and army co-operation aircraft

Eight months later, when Rumanian forces joined German forces in the invasion of the Soviet Union on June 22,1941, the Rumanian *Divisia I-a Aeriană* possessed two squadrons each of nine Potez 633s based at airfields North of Râmnicu Sărat, near the Bessarabian border, and forming the 1st Group of the 2nd Bomber Regiment. The Potez 633s were deployed in support of the Rumanian 3rd and 4th Armies' offensive across Bessarabia which culminated in the capture of Odessa on October 16, 1941, their primary tasks being tactical reconnaissance and the harrying of the retreating Soviet columns. By 1942, the availability of Junkers Ju 88As resulted in the withdrawal of the Potez 633 and its relegation to the advanced training role, a task in which it was joined later in the year by a number of refurbished ex-*Armée de l'Air* Potez 63.11s acquired from the Vichy Government in exchange for oil.

POTEZ 637

At an early stage in the development of the Potez 63 a variant had been proposed for tactical reconnaissance and army co-operation, and the initial order placed by the *Ministère de l'Air* for 10 prototype and evaluation aircraft had included a prototype of the Potez 637 A3 (*Armée Triplace*) intended to undertake these tasks, this, the **Potez 637.01,** flying at Méaulte in the summer of 1938, and commencing official trials at the CEMA at Villacoublay in September of that year.

Possessing an essentially similar airframe to that of the Potez 631 and 633, the three-seat Potez 637 differed externally in having a ventral observation gondola of 1 ft. 8 in. depth. A Labrely F20, F30 or F50 camera could be installed aft of the gunner's cockpit, together with an Alkan rack for 40 vertically-stowed marker flares, and fuel tankage was substantially increased, the capacity of the centre section tanks was increased to 104.5 Imp. gal. which, with a 33 Imp. gal. tank in each outer wing panel, provided a total capacity of 275 Imp. gal. Armament was similar to that of the Potez 633 light bomber, comprising one fixed forward-firing MAC 1934 gun and a similar weapon on a flexible mounting, although this was later augmented by a rear-firing pedal-operated MAC 1934 gun on a wobble-mount in the ventral gondola. A

POTEZ 637 A3 SPECIFICATION

Type: *Three-seat Reconnaissance and Army Co-operation Aircraft.* **Power Plants:** *Two Gnôme-Rhône 14M 6/7 14-cylinder air-cooled radial engines each rated at 700 h.p. for take-off and 660 h.p. at 13,200 ft.* **Armament:** (*Defensive*) *One fixed forward-firing 7.5-mm. MAC 1934 machine gun with 300 rounds in nose, one 7.5-mm. MAC 1934 machine gun with 500 rounds on flexible mounting in rear cockpit, and one 7.5-mm. MAC 1934 machine gun with 300 rounds on wobble-mount in rear of ventral cupola.* (*Offensive*) *Two 110-lb. bombs on underwing racks.* **Performance:** *Maximum speed, 210 m.p.h. at sea level, 245 m.p.h. at 13,780 ft.; maximum cruising speed, 227 m.p.h. at 13,120 ft.; economical cruising speed, 189 m.p.h. at 13,120 ft.; maximum range, 1,135 mls.; absolute ceiling, 27,220 ft.* **Weights:** *Empty, 6,370 lb.; loaded (clean), 8,940 lb.; maximum, 9,285 lb.* **Dimensions:** *Span, 52 ft. 6 in.; length, 36 ft 3¾ in.; height, 11 ft. 9¾ in.; wing area, 351.979 sq. ft.*

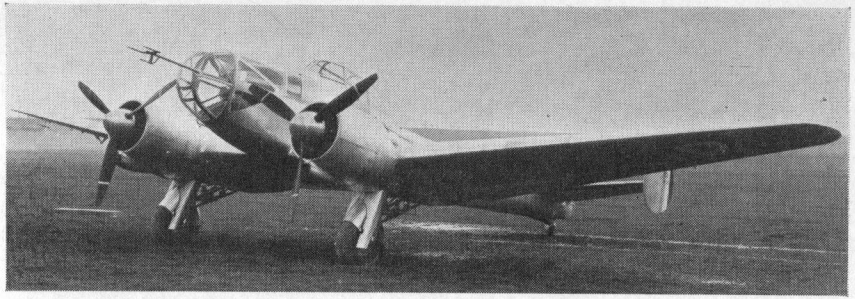
110-lb. bomb could be carried beneath each outer wing panel, and radio equipment consisted of a SARAM Type 0.12 R/T set.

The Potez 637 No. 01 was flown from Villacoublay to Istres for official performance trials on December 10, 1938, these being completed 12 days later. It had been anticipated that the drag of the ventral gondola would sharply reduce performance, a fact confirmed by the Istres trials, but the Potez 637 was considered an interim type pending the availability of the more extensively modified Potez 63.11 which had been ordered into production off the drawing board at the same time as the order for 60 examples of the Potez 637 had been placed in the summer of 1938.

The **Potez 637 A3 No. 1** was completed in April 1939, a further eight aircraft being completed in that month. Seventeen were completed in May, 18 in June, seven in July, and the remaining nine in August, and the first deliveries were made to the 2e *Groupe* of the 33e *Escadre de Reconnaissance* at Essey-les-Nancy, followed by the 1er *Groupe* of the 52e *Escadre* at the same base, both units converting from the Potez 542. On September 3, 1939, GR II/33 and I/52 had been joined in the strategic reconnaissance role by GR I/33 and II/52 with Potez 637s, but the 52e *Escadre* still had 10 Potez 542s on strength in addition to 23 of the later aircraft. Pending their re-equipment with Potez 63.11s, GR I/36 and II/36 had each received three Potez 637s within two weeks of the commencement of hostilities to supplement their obsolete Potez 540s, and the severe losses suffered by day reconnaissance units operating the Bloch 131 resulted in the decision to permit only the Potez 637 to cross the enemy lines on reconnaissance missions in daylight. Even the Potez 637 fared badly on such missions, and by May 10, 1940, GR I/52 was in process of converting to the Bloch 174 at St. Dizier, GR II/52 had largely re-equipped with the Potez 63.11 at Couvron, and both GR I/33 and II/33 were converting to the Bloch 174 at Dôle and Athiés-sous-Laon respectively.

POTEZ 63.11

When, in the summer of 1938, the *Ministère de l'Air* placed a production order for the Potez 637 A3 as the first step in providing the *Armée de l'Air* with urgently-needed modern equipment for its reconnaissance units, it was accepted that this aircraft would suffer certain performance shortcomings and could not be



The Potez 63.11 A3 No.01 with the original glazed nose which was later redesigned to improve downward view

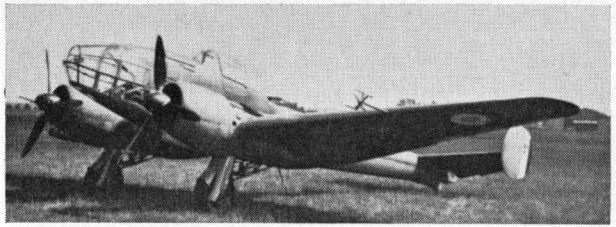
considered, therefore, as anything more than a stop-gap until a more suitable aircraft became available. This aircraft was the Potez 63.11 which, although another derivative of the highly versatile Potez 63, was, nevertheless, a major redesign intended specifically for the *Groupes Aériens d'Observation*. At the time the Potez 637 was ordered, the Potez 63.11 was still on the drawing board. Nevertheless, an initial batch of 145 examples of the later aircraft was ordered simultaneously, but as the new machine utilized the same wings, power plants, undercarriage, rear fuselage and tail assembly, the risk was negligible, and when the prototype, the **Potez 63.11 A3 No. 01,** flew for the first time at Méaulte on December 31, 1938, it proved to possess the same pleasant flying qualities that had characterised its predecessors in the Potez 63 family.

The Potez 63.11 featured an entirely redesigned nose section and centre fuselage. The observer was positioned in the extensively glazed nose, the pilot's cockpit being moved aft and the radio-operator/gunner retaining his position over the wing trailing edge. The Potez 63.11 No. 01, the first of three prototypes, differed from subsequent production models in the shape of its glazed nose which was curved in side profile. After CEMA trials, the French Air Staff instructed the SNCAN team at Méaulte to redesign the extreme nose to improve downward view, requesting the inclusion of a flat glazed panel. The lengthened, more angular nose was tested on all three prototypes, fully met requirements and was standardised for the production aircraft, the first of which flew on July 10, 1939.

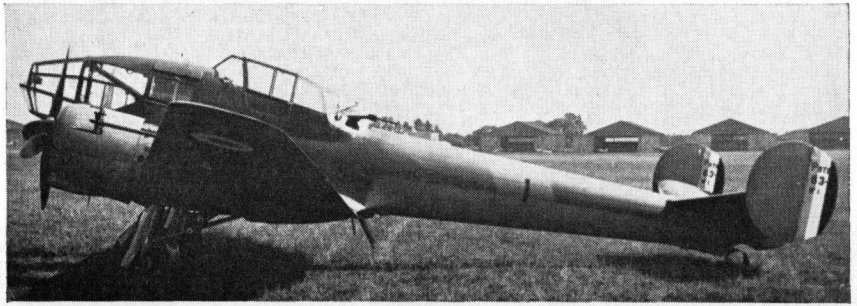
The importance attached to re-equipping the *Groupes Aériens d'Observation* with the Potez 63.11 A3 can be gauged from the fact that contracts placed in 1939 alone called for 1,684 aircraft of this type, production being shared between the SNCAN's Méaulte and Les Mureaux plants and attaining 120 aircraft per month by May 1940. Unfortunately, production of the Ratier 1527/8 three-blade

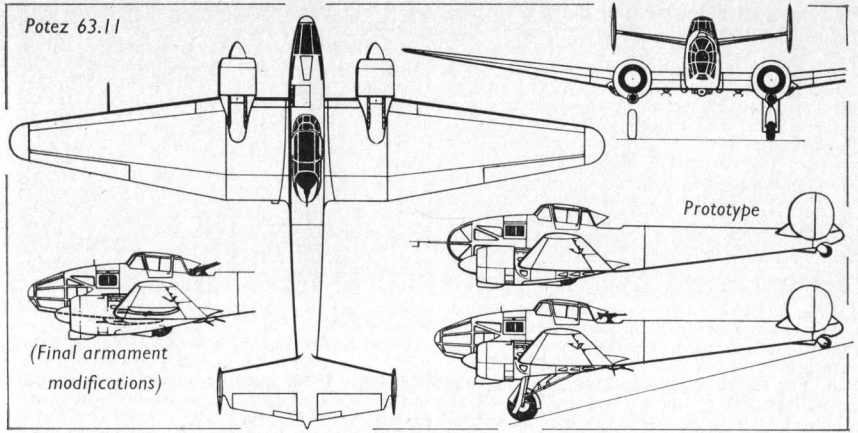
variable-pitch metal airscrew was unable to keep pace with the airframe production, and a substantial number of aircraft had to be delivered to the GAOs with provisional fixed-pitch two-bladed wooden airscrews with which they were not allowed to fly reconnaissance sorties of more than 20 miles over enemy territory.

The Potez 63.11 was powered by either the Gnôme-Rhône 14M 4/5 driving Ratier 1527/8 airscrews or the Gnôme-Rhône 14M 6/7 driving GR 2190/1 airscrews, although, as previously mentioned, many were initially flown with Levasseur 50177/8 two-bladed fixed-pitch airscrews. Two fuel tanks in the wing centre section accommodated a total of 166.75 Imp. gal., a further 41 Imp. gal. being distributed between two tanks in the outboard panels. A SARAM 3.10 R/T set was accommodated in the rear cockpit, and for day reconnaissance a swivelling F30 camera and a fixed F20 camera were carried. Auxiliary controls were provided the observer for emergency use. These comprised rudder pedals, a removable control column, a throttle quadrant, ignition switches, compass, air speed



(*Left and below*) *The Potez* 63.11 *No.*1 *which flew for the first time on July* 10, 1939





POTEZ 63.11 SPECIFICATION

Type: *Three-seat Tactical Reconnaissance and Army Co-operation Aircraft.* **Power Plants:** *Two Gnôme-Rhône* 14*M* 4/5 14*-cylinder air-cooled radial engines each rated at* 700 *h.p. for take-off and* 660 *h.p. at* 13,200 *ft.* **Armament:** *One fixed forward-firing and one fixed aft-firing* 7.5*-mm. MAC* 1934 *machine gun each with* 600 *rounds, and one aft-firing MAC* 1934 *machine gun on flexible mounting with* 600 *rounds in rear cockpit, or* (*definitive*) *three fixed forward-firing* 7.5*-mm. MAC* 1934 *machine guns beneath* (*plus four forward-firing* 7.5*-mm. MAC* 1934 *guns under outboard wing panels on some machines*), *two* 7.5*-mm. MAC* 1934 *machine guns on flexible mounting in rear cockpit, and three* 7.5*-mm. MAC* 1934 *M*39 *machine guns firing aft beneath fuselage plus four* 110*-lb. bombs.* **Performance:** (*At* 9,773 *lb.*) *Maximum speed,* 209 *m.p.h. at sea level,* 237 *m.p.h. at* 8,200 *ft.,* 264 *m.p.h. at* 18,045 *ft.; maximum cruising speed,* 230 *m.p.h. at* 14,765 *ft.; economical cruising speed,* 186 *m.p.h. at* 14,765 *ft.; maximum range,* 932 *mls.; initial climb rate,* 1,653 *ft./min.; time to* 3,280 *ft.,* 2 *min., to* 9,840 *ft.,* 6 *min., to* 19,685 *ft.,* 12.5 *min.; service ceiling,* 27,890 *ft.* **Weights:** *Empty,* 6,911 *lb.; maximum loaded,* 9,987 *lb.* **Dimensions:** *Span,* 52 *ft.* 6 *in.; length,* 35 *ft.* 10⅜ *in.; height,* 10 *ft.* 1¼ *in.; wing area* 351.979 *sq. ft.*

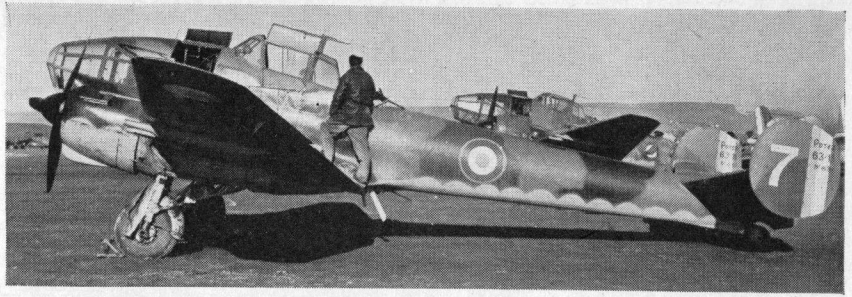
indicator and altimeter, but did not include engine instrumentation, undercarriage or flap controls, it being intended that the observer would fly the aircraft until a crash landing could be made in friendly territory in the event of the pilot being incapacitated.

Fixed armament comprised two pneumatically-operated 7.5-mm MAC 1934 machine guns with two 300-cartridge drums each, one located in a ventral fairing and aimed by the pilot by means of an OPL 31M sight, and the other firing aft, protruding from the fuselage belly at a 5° negative angle and fired by means of a foot pedal depressed by the gunner. A third defensive weapon of similar type was situated in the rear cockpit on a Type 28 flexible mounting. Six simple racks were provided beneath the centre section and the outboard wing panels, two of these carrying flares for nocturnal sorties with full fuel. For night target marking, fuel was restricted to the centre section tanks, and in addition to two flare bombs on the centre section racks, eight marker flares were carried internally. In the day bombing and close support role the F30 camera was removed and four 110-lb. bombs were attached to the outboard wing racks.

OPERATIONAL CAREER OF THE POTEZ 63.11

The first Potez 63.11 A3 aircraft were delivered in November 1939 to the *Groupe de Reconnaissance* II/52, and in the same month GR I/52 and II/33 began to receive this new equipment, followed in December by GR I/36 and II/36, and the first operational sortie with the Potez 63.11 was flown by GR I/33 on February 13, 1940. Conversion of units to the Potez 63.11 continued throughout the winter of 1939–40, GR I/14, I/22, II/22, I/35, II/39, I/55 and II/55 re-equipping, together with several *Groupes Aériens d'Observation* for which a training and conversion unit had been established at Toulouse in October. Other *Centres d'Instruction* were progressively established for the GAOs, and when the *Wehrmacht* launched its *Blitzkrieg* on May 10th, the following GAOs each had six Potez 63.11s on strength: GAO 501, 502, 503, 504, 505, 1/506, 2/506, 507, 1/508, 2/508, 509, 510, 511, 512, 513, 1/514, 515, 516, 517, 518, 1/520, 2/520, 543, 544, 545, 546, 547, 548, 1/551, 2/551, 3/551, 4/551, 552 and 553. In addition, GAO 2/514, 581, 582, 1/584 and 1/589 were in process of conversion to the Potez 63.11, while GR II/14 was being formed on the type. Overseas, GAO 1/583 in the Levant and the *Section d'Observation du Groupe Aérien Mixte* 550 in Corsica were also flying the Potez 63.11.

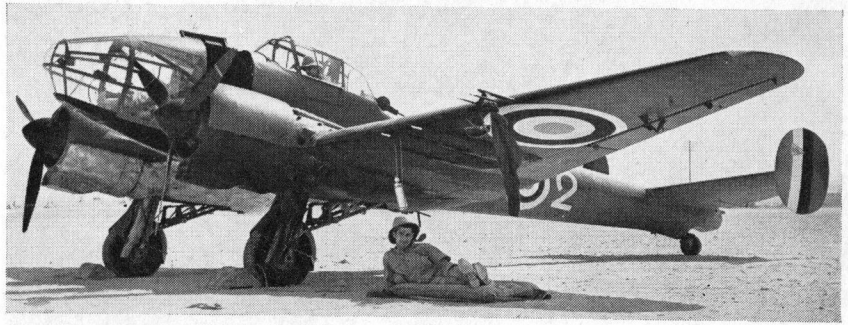
For effective use, the Potez 63.11 needed fighter protection, and this was rarely forthcoming in May–June 1940. In consequence, more aircraft of this type were lost than any other type in operational service with the *Armée de l'Air*, and had it not been for the manœuvrability of the aircraft during hedge-hopping operations and its sturdiness despite relatively light construction, losses would have undoubtedly been very much heavier. Apart from its reconnaissance tasks, the Potez 63.11 had to be used in the desperate efforts that the *Armée de l'Air* made to stem the advance of the *Panzer* units, and fortunately the armament of the aircraft could be increased with relative ease. Maintenance units added two MAC 1934 machine guns beneath the fuselage centre section and four similar weapons in fairings beneath the outboard wing panels. Four hundred of the special mountings demanded by the conversion programme were delivered within 12 days of the order being signed. The fixed rear-firing gun beneath the rear cockpit was supplanted by a trio of belt-fed MAC 1934 M39 guns. These were hinged to an axis

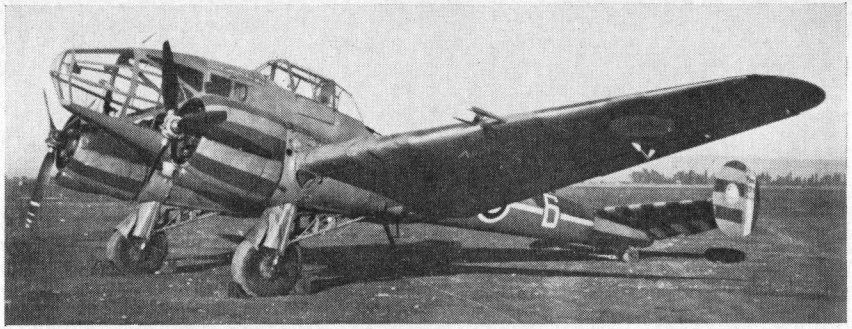


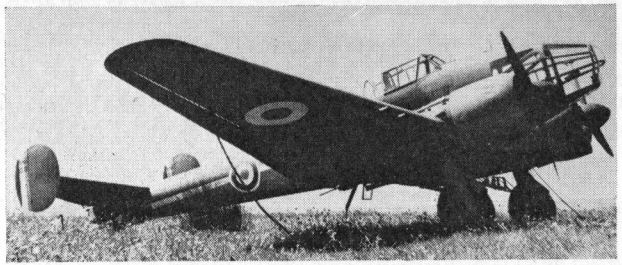
(*Above*) *Potez* 63.11 *No.*831 *operating with Allied forces in North Africa in* 1943, *and* (*below*) *a Potez* 63.11 *operated by the Free French No.*2 (*Fighter*) *Flight*

at the rear end of the breech casing and when fired simultaneously the shaking resulted in the bullets being distributed in a wide swathe. Furthermore, the single gun in the aft cockpit was replaced by twin 7.5-mm. weapons coupled on a SAMM AB68 mounting.

From June 11, 1940, the Potez 63.11-equipped GAO 590 flew operational sorties against Italian forces in Libya, and the *Section d'Observation du GAM* 550 reconnoitred







(*Above*) *A Potez* 63.11 (*No.*411) *of GR* 1/36 *of the Vichy-controlled Armée de l'Air, and* (*left*) *a Potez* 63.11 *with underwing armament*

Sardinia and Elba, but under the terms of the Armistice, GR I/33, I/35, II/36, I/52, I/55 and II/55, and all GAOs with the exception of 1/583 were disbanded, although GR I/52 was to be resurrected on September 1, 1940. Some crews escaped to British-held territory with their Potez 63.11s, and at least two (Potez 63.11 A3 Nos. 838 and 842) reached Britain. Some of the Potez 63.11s which escaped from French-administered territories in the Middle East were operated by the Free French from Egypt against Italian forces, and during 1941, the Vichy government formed GAO 555 with the Potez 63.11, basing this unit at Tananarive-Ivato (Madagascar), but in July of that year the similarly-equipped GR II/39 and GAO 1/583 were disbanded after some action against British forces in Syria and the Lebanon. In the winter of 1941–42, the Vichy-controlled *Aéronavale's Escadrille* 4BR converted to the

Potez 63.11, thus becoming the first and only *Aéronavale* combat unit to operate this type.

Production of the Potez 63.11 was resumed after the German occupation of the SNCAN plants in June 1940, a further 100 being completed at Les Mureaux. A substantial number of aircraft of this type that had been awaiting collection by ferry pilots had been captured by the *Wehrmacht* and, together with the additional Les Mureaux-built machines, were impressed by the *Luftwaffe* for training and liaison tasks. How many Potez 63.11s actually found their way into *Luftwaffe* service in this fashion is uncertain, but the number was undoubtedly quite substantial. SNCAN's Les Mureaux plant turned out its first production aircraft (Potez 63.11 A3 No. 146) three months after the Méaulte plant, in September 1939. With the approach of the German forces, the Méaulte assembly line had been transferred to Evreux where 28 machines were completed between the 16th and 31st of May 1940. By the latter date, total Potez 63.11 production had reached 702 aircraft, of which 431 had been produced at Méaulte and 243 at Les Mureaux. The latter plant was producing components for both assembly lines, and nose section No. 976 had just been completed when, on June 10, 1940, the facilities at Les Mureaux were evacuated. The final total production figure is uncertain, the highest known production number being 866 which appeared on an aircraft operated by GR I/36 at Sétif in November 1942, but the Potez 63.11 was certainly being completed at a rate much faster than it could be absorbed by the *Armée de l'Air*.

There were also substantial numbers of Potez 63.11s in the Unoccupied Zone and, in 1942, a number of these were exchanged by the Vichy government with the Rumanian government for petrol. On November 8, 1942, Vichy-controlled *Armée de l'Air* units flying Potez 63.11s were GR I/14 at Perpignan, GR II/14 at Avignon, GR II/22 at Montpellier,

A Potez 63.11 *serving in the training role with the Luftwaffe. A substantial number of Potez* 63.11*s saw Luftwaffe service*

GR I/36 at Sétif, GR I/52 at Marrakesh and GR II/63 at Thiès, each with a statutory strength of 13 aircraft. On the 28th of that month, GR I/14, II/14 and II/22 were disbanded and their equipment seized by the *Luftwaffe*, together with similar aircraft stored by the *Bases de Stockage*, the Germans acquiring nearly 100 additional Potez 63.11s in this way.

EXPERIMENTAL VERSIONS OF THE POTEZ 63

Potez 635 CN2: An experimental night fighter version of the Potez 631 C3 was proposed as the Potez 635 CN2 (*Chasse de Nuit*), the principal modification being the deletion of one cockpit and the installation of two 20-mm. Hispano-Suiza cannon fixed to fire forward and upward at an angle of 20 degrees. No prototype was built.

Potez 639 AB2: An attack bomber based on the Potez 633 B2 airframe was tested under the designation Potez 639 AB2 (*Assaut-Bombardement*), this having a single 20-mm. Hispano-Suiza cannon mounted ventrally at a negative angle of 14° for ground strafing, five 110-lb. bombs stowed vertically in the bomb-bay, five additional 110-lb. bombs on underwing racks, and extensive armour protection for the crew and fuel tanks.

Potez 63.12 C3: The Potez 631 C3 No. 40 airframe was experimentally fitted with two Pratt & Whitney SB4G Twin Wasp Junior radials and flown at Méaulte on December 29, 1938 as the Potez 63.12 C3 fighter.

Potez 63.13 Bp2: A conversion of a Potez 633 airframe, the Potez 63.13 Bp2 (*Bombardement en Piqué*) two-seat dive-bomber was flown on August 8, 1939 at Méaulte. Fitted with air brakes beneath the centre section, Chauvière reversible-pitch airscrews, modified elevators and more minor changes, the Potez 63.13 Bp2 had two 20-mm. cannon beneath the fuselage and carried four 110-lb. bombs on underwing racks, and was developed to the same programme as the Bre 698.

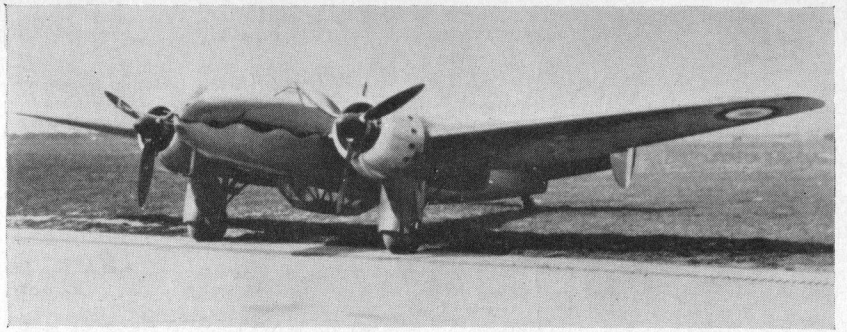
Potez 63.16 T3: Basically a Potez 63.11 airframe with a wing of increased span and area, the Potez 63.16 T3 (*Travail*) was an army co-operation crew trainer which flew for the first time at Méaulte on January 3, 1940, and was flown from Villacoublay to Orleans-Bricy on February 26th for CEMA trials.

POTEZ 220

FRANCE

After absorption by the Société Nationale de Constructions Aéronautique du Nord (SNCAN) on June 1, 1937, the design team of the ANF Les Mureaux headed by André Brunet continued the independent development of the Mureaux aircraft line, but owing to the international prestige attached to the name Potez, the facilities of which concern had also been nationalised as a part of the SNCAN, this appellation was employed for all SNCAN designs irrespective of the design team with which they originated. Thus, the Potez 220 tactical reconnaissance and army co-operation three-seater built at the Sartrouville plant of the SNCAN began life on the drawing boards of the former ANF Les Mureaux design team.

Somewhat surprisingly, the Potez 220 powered by a pair of small Gnôme-Rhône 14M 4/5 radials was designed to the requirements of the same *Programme Technique* A24 which, issued on February 6, 1937, resulted in the Bloch 174 and was also met by the Martin 167F. The Potez 220 was of somewhat

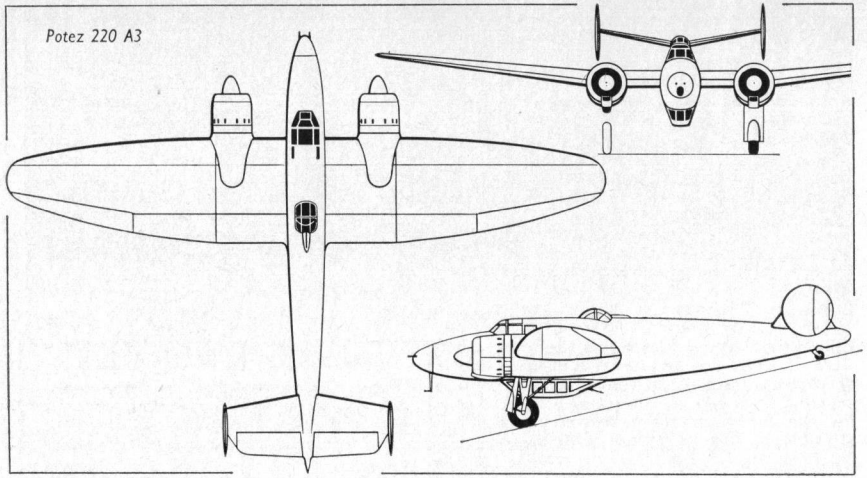


The Potez 220 No.01 (above) was flown on April 7, 1939, and despite its low power was developed to the requirements of the Programme Technique A24 which also resulted in the Bloch 174. Although bearing the Potez appellation, this aircraft was developed by the former ANF Les Mureaux design team which, together with that of Potez, had been absorbed by the SNCAN when this organisation was formed on June 1, 1937

less advanced concept than the Bloch 174, housing the observer in a glazed gondola slung beneath the fuselage. The oval-section all-metal monocoque fuselage housed pilot, observer and radio-operator/gunner. Dual controls were available to the observer when not occupying his ventral gondola, and eight 22-lb. marker flares could be accommodated internally. The two-spar wing comprised a centre section housing four of the six fuel tanks which had a total capacity of 308 Imp. gal., the remaining pair of tanks being situated

POTEZ 220 SPECIFICATION

Type: *Three-seat Tactical Reconnaissance and Army Co-operation Aircraft* **Power Plants:** *Two Gnôme-Rhône 14M 4/5 14-cylinder radial air-cooled engines each rated at 700 h.p. for take-off and 660 h.p. at 13,200 ft.* **Armament:** *Two fixed forward-firing 7.5-mm. MAC 1934 machine guns with 300 r.p.g., one 7.5-mm. MAC 1934 machine gun on flexible mounting with 600 rounds firing from dorsal position, and one 7.5-mm. MAC 1934 machine gun on flexible mounting with 400 rounds firing aft from ventral gondola. (Offensive) Four 110-lb. bombs on underwing racks.* **Performance:** *Maximum speed, 237 m.p.h. at sea level, 280 m.p.h. at 13,120 ft.; climb to 13,120 ft., 6.25 min.; maximum range, 994 mls.* **Weights:** *Empty, 6,554 lb.; loaded, 9,945 lb.* **Dimensions:** *Span, 50 ft. 5 in.; length, 36 ft. 8 in.; height (tail up), 12 ft. 0½ in.; wing area, 370.278 sq. ft.*



in the outer panels immediately outboard of the engine nacelles. The wing was of all-metal construction with hydraulically-operated flaps, and the Gnôme-Rhône 14M radials drove three-bladed Ratier 4527/4528 electric airscrews.

Two prototypes were built at Sartrouville, the **Potez 220 No. 01** flying on April 7, 1939 and the **Potez 220 No. 02** following on October 20, 1939, the latter differing in having two GR 14M 5 engines both rotating in an anti-clockwise direction, and Olaer long-stroke undercarriage shock absorbers in place of the short-stroke Messier shock absorbers of the first prototype. A proposed variant of the basic design, the Potez 221, was to have been essentially similar to the Potez 220 No. 01 apart from having the ventral gondola deleted and a glazed nose introduced for the observer, and the 7.5-mm. machine gun on a flexible mounting in the rear of the gondola replaced by a similar weapon on a wobble mount.

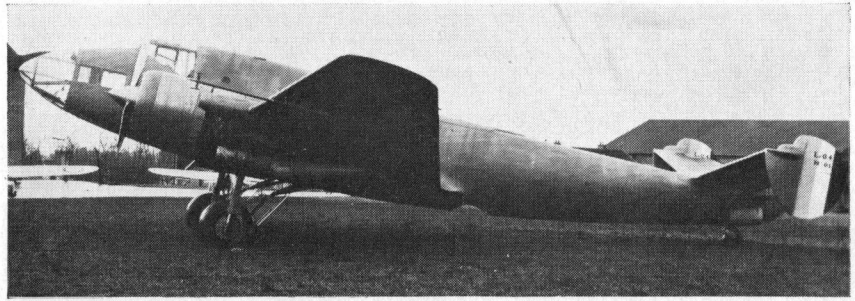
The Potez 220 offered a slightly higher performance than that of the Potez 63.11, but as the latter was already in large-scale production by the time the prototypes of the Potez 220 flew, there was little chance of a production order for the later type, and after some flight testing further development of the basic design was abandoned.

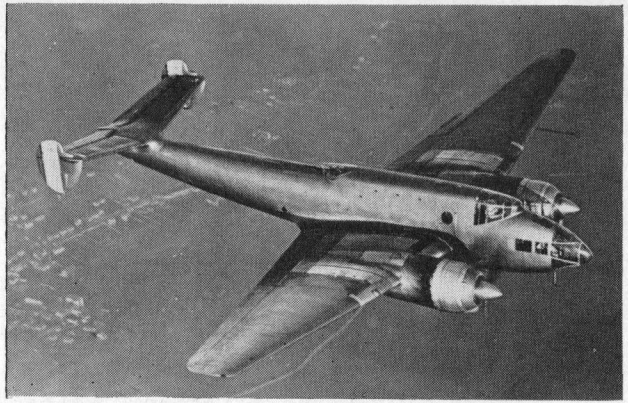
While French bomber design had achieved some notoriety for the unrelentingly ugly warplanes to which it had given birth, the years 1937–38, which saw the débuts of the LeO 45 and Amiot 340, reveal all too clearly the fact that French combat aircraft designers had not been oblivious of developments in aerodynamics. Gone were the sharp angles, bulbous turrets and other drag-evoking features that had come to be considered characteristic of the French bomber. Here were graceful, exquisitely feminine curves; aircraft benefiting from every state-of-the-art aerodynamic refinement. What is more, their effeminate, almost delicate contours belied their inherent sturdiness.

The LeO 45 series of medium bombers, stemming from a specification issued on November 17, 1934 by the *Service Technique de l'Aéronautique* calling for a B4 aircraft, a four-seat medium bomber with a 2,645-lb. bomb load, a 435-mile radius of action and a long-range cannon defensive armament, were probably the most shapely warplanes in their category. Although relatively large and heavy, they were to prove highly manoeuvrable and, without bomb load, fully aerobatic. Extremely efficient and, in some respects, technically ahead of their time, they offered smooth handling characteristics and excellent engine-out performances which, coupled with their speed and effective armament, were to endear them to their crews.

Competing projects were the Amiot 341, the Latécoère 570, and the Romano 120, and the **LeO 45–01**, which, designed by a team led by Jean Mercier and built at the Argenteuil plant of the Lioré-et-Olivier concern, was flown for the first time on January 16, 1937, was of more advanced design concept than the other contending prototypes. Five weeks after the LeO 45-01's first flight, the Lioré-et-

The LeO 45.01 *seen late in* 1937 *after the introduction of projecting oil coolant radiators and redesigned and lowered vertical tail surfaces*





The LeO 451–01 photographed undergoing an early flight test during November 1938. CEMA trials were initiated during the following month

Olivier company was nationalised as part of the *Société Nationale de Constructions Aéronautiques du Sud-Est* (SNCASE). Handling characteristics of the prototype during flight trials were generally satisfactory, although there was a marked tendency to swing during take-off. In an effort to rectify this shortcoming, the endplate vertical tail surfaces were redesigned and lowered, and substantially larger horn-balanced rudders were fitted, flight testing after these modifications being resumed on July 16, 1937.

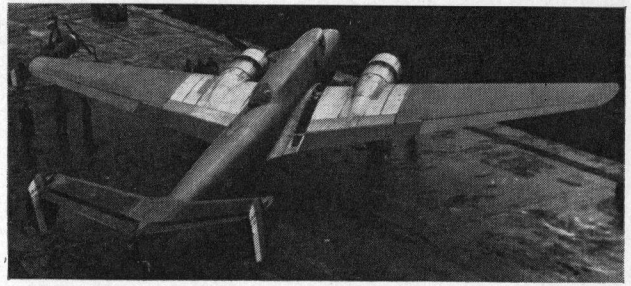
Official trials at the CEMA (*Centre d'Essais du Matériel Aérien*) began on September 2nd, and eight days later the LeO 45-01 attained a speed of 388 m.p.h. in a shallow dive between 16,400 and 5,900 ft. The oil coolant radiators which were flush with the wing leading edges had, meanwhile, proved unsatisfactory, and on October 23rd flight testing began with projecting radiator intakes, but the principal Achilles Heel of the prototype was its Hispano-Suiza 14AA 08/09 14-cylinder radial air-cooled engines which, rated at 1,078 h.p. for take-off and 1,100 h.p. at 9,350 ft., had been constantly troublesome, and on December 6th both power plants cut simultaneously, necessitating a forced landing in a ploughed field at Saclay. Fortunately, the prototype suffered no damage and, after replacement of the engines, succeeded in taking-off once more for Villacoublay. Despite the unsatisfactory state of development of the HS 14AA engine, this power plant was specified when an initial contract for 20 production LeO 45s was awarded in January 1938. In the following month, the LeO 45-01 was returned to the SNCASE to have Mercier engine cowlings fitted and slight dihedral applied to the wingtips, flight testing being resumed on April 30, 1938, but continued difficulties with the Hispano-Suiza engines during resumed CEMA

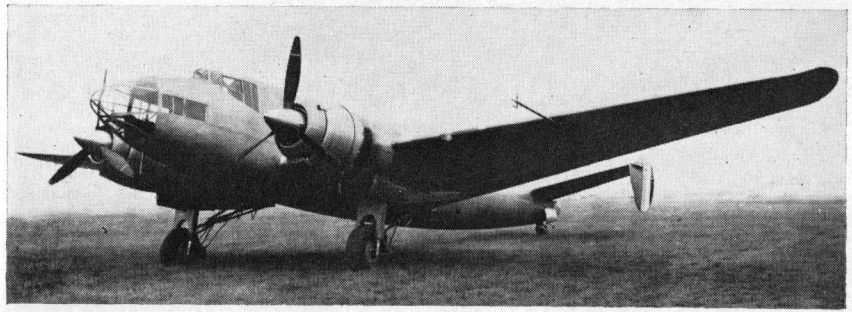
trials finally led, on August 29, 1938, to the decision to switch to the more reliable Gnôme-Rhône 14N, the prototype having completed 97 flights totalling 66 hr. 45 min. by August 29, 1938.

Re-engined with Gnôme-Rhône 14N 20/21 Mistral-Major 14-cylinder radials rated at 1,030 h.p. and redesignated **LeO 451-01,** the prototype resumed its flight test programme on October 21, 1938.

In the meantime, the initial order for 20 LeO 45s together with a similar order placed on March 25, 1938 had been amended to cover the LeO 451, and an order for a further 100 aircraft had been

The LeO 451–01 (below) was originally the LeO 45–01. The change in designation accompanied the installation of Gnôme-Rhône 14N 20/21 engines which supplanted the unreliable Hispano-Suiza 14AA radials in September–October 1938. The initial production model of the LeO 451 was virtually identical to the definitive LeO 451–01



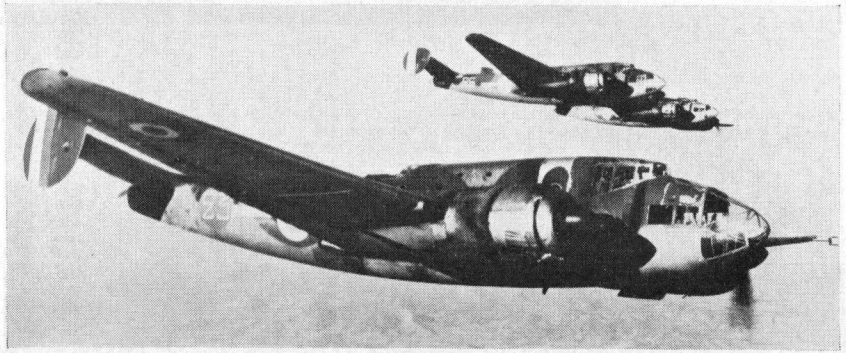


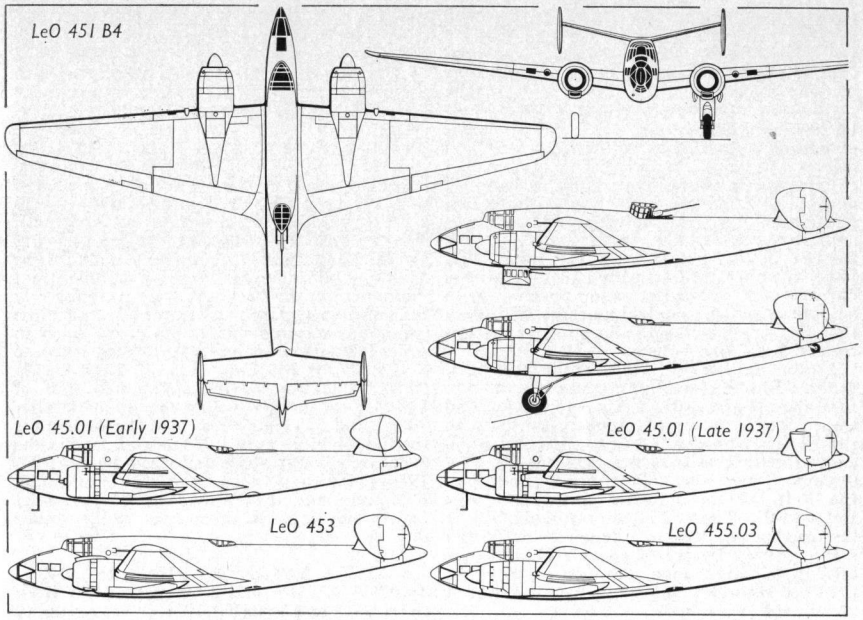
awarded, the production of which was being initiated by the SNCASE plants at Clichy and Levallois in the suburbs of Paris, assembly being undertaken at Villacoublay. The LeO 451-01 began CEMA tests in December 1938, attaining 311 m.p.h. in level flight at 16,400 ft. on January 19, 1939, and successfully completing official trials during the following month.

The first production aircraft, the **LeO 451 No. 1**, flew at Villacoublay on March 24, 1939, being followed by the second aircraft on April 28th, the latter having two Gnôme-Rhône 14N 39 engines, the shafts of which both rotated in a lefthand direction, although this installation was not adopted for subsequent aircraft. An experimental flight equipped with the LeO 451 was formed during the late spring, and LeO 451 No. 10 was delivered to the *Armée de l'Air* on August 16, 1939, by which time the *Aéronavale* was evincing interest in the bomber and had begun evaluating the type. Between January 1, 1939 and the commencement of World War II, two additional orders had been placed totalling 602 LeO 451s and five examples of a specialized high-altitude version, the LeO 457, while in March 1939 the Greek government had ordered 12 LeO 451s with 7.92-mm. Browning machine guns and racks for 16 vertically-stowed 120-lb. bombs.

With mobilization, the experimental LeO 451 flight was absorbed by the Bloch 200-equipped 31e *Escadre* which, on August 30, 1939, had five of the new bombers on strength. From the start of hostilities the LeO 451s flew long-range reconnaissance missions over Germany, and on October 6th the first aircraft of this type was lost in action, LeO 451 No. 6 being shot down near Enskirchen by Bf 109E fighters of *Jagdgeschwader* 2. On September

This photograph of a trio of Armée de l'Air LeO 451s (with ultimate vertical surfaces) reveals clearly the graceful lines of this medium bomber





16, 1939 the 12e *Escadre* had begun converting to the LeO 451, and by this time many sub-contractors had joined the production programme, and a second assembly line had been initiated at Ambérieu, the first machine to come off the line, the LeO 451 No. 11, flying on October 1, 1939, this being assembled from components manufactured in the Paris area, the second machine, the LeO 451 No. 30 which flew on October 19th, being assembled primarily from components produced in the Lyons and Saint Etienne areas.

The LeO 451 possessed an all-metal monocoque fuselage of narrow oval section with 60 main and auxiliary frames interconnected by longitudinal stringers. In order to keep the cross section to the minimum and still provide the stipulated walkway alongside the bomb-bay

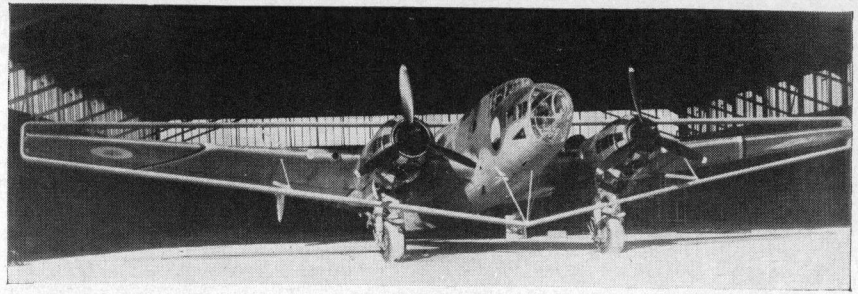
(to starboard) to connect fore and aft crew stations in flight, Jean Mercier had reduced the size of the fuselage bomb-bay, compensating for the smaller stowage capacity by providing supplementary bomb-bays in the wing roots. This necessitated two different types of wing structure, the inboard panels consisting of two spars with steel booms and duralumin webs, between which were the supplementary bomb-bays and fuel tanks, covered by corrugated sheet, with the corrugations running fore and aft, and finally with smooth sheet, and the outer panels having a torsion box structure with the upper and lower members of corrugated sheet, with the corrugations spanwise, and covered with smooth sheet. All control surfaces, including the electrically-actuated flaps, were metal-framed and fabric-covered.

Production LeO 451s had, for the most part, Gnôme-Rhône 14N 48/49 engines of 1,140 h.p. for take-off and 1,035 h.p. at 15,750 ft., and these, for purposes of standardisation with the similarly-powered Amiot 351s and 354s, drove Ratier 1634/1635 airscrews of 10 ft. 6 in. diameter which were slightly less efficient than the 10 ft. $10\frac{3}{4}$ in. diameter airscrews of the LeO 451-01. The first 80 aircraft had a TA 35 bombsight, but this was replaced on subsequent aircraft by the Bronzavia D30. Some later production machines also introduced modified elevators featuring a lengthened root chord, and an elongated tail cone.

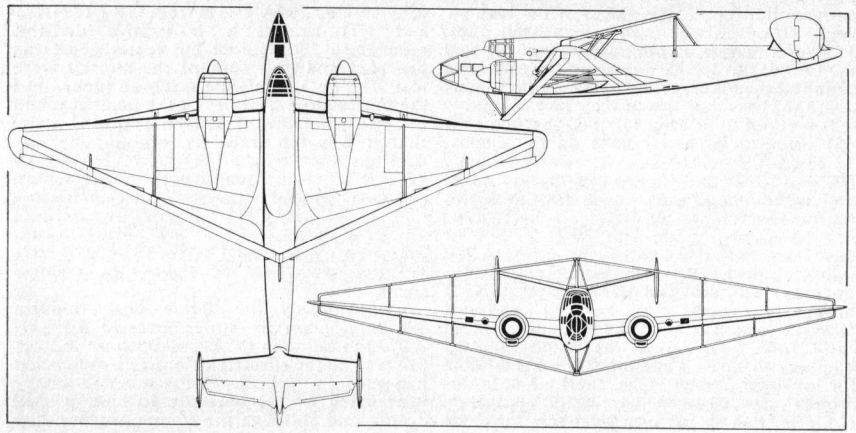
A third SNCASE assembly line was established at Marignane, and the first production aircraft from this line, LeO 451 No. 262, was flown on April 13, 1940, by which time the Ambérieu plant had turned out its 100th aircraft, and the *Société Nationale de Constructions Aéronautiques de l'Ouest* (SNCAO) plant at Bouguenais had also joined the production programme. An underground factory specifically for LeO 451 production had been prepared at Cravant, near Auxerre, but such was the speed of the German advance that the personnel evacuated from the SNCASE plant at Villacoublay were unable to re-establish themselves in the new facilities. Substantial additional orders had been placed for LeO 45 series aircraft with the commencement of hostilities, these including a contract for 400 LeO 451s and 455s placed with the SNCAO, and contracts for 48 LeO 456s, an LeO 454 and 199 LeO 458s, bringing total orders to 1,255 machines (excluding the Greek contract). The number of production man-hours per aircraft had been progressively reduced to 51,000, and in order to ease sub-contract manufacture, the fuselages were progressively built in two (junction at frame 55) and three (junctions at frames 38 and 55) parts. Early in 1940, further orders had been placed with the SNCASE for 150 LeO 451s, 20 LeO 451Ms (this designation having supplanted that of LeO 456 for the *Aéronavale* version in October 1939), and 358 LeO 458s, bringing orders for the French services to 1,783 aircraft, but in the event only 452 of these had flown by June 25, 1940, including 53 from the SNCAO assembly line, and many of these were to be destroyed before they could be taken over by the *Armée de l'Air*.

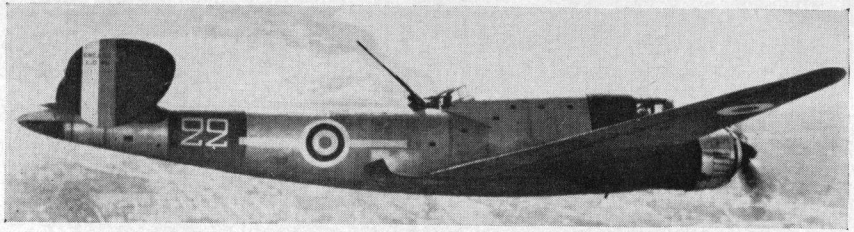
CAREER PRIOR TO JUNE 23, 1940

The 31e *Escadre* had been withdrawn from operations in December 1939 so that it could complete conversion from the Bloch 200 to the LeO 451. The 12e *Escadre* had already begun conversion within two weeks of the commencement of hostilities, and the 11e and 23e *Escadres* followed suit in February 1940. By comparison with the previous equipment of these units, the LeO 451 was an advanced type indeed, and both aircrews and ground staff had to accustom themselves to the bomber's appreciably more complex equip-



LeO 451 No.359 of the Aéronavale's Escadrille 6B experimentally equipped for mine-sweeping, and flown in this form on June 3, 1942 at Tafaraoui-Lartique. Additional bracing struts (as shown below) were added after initial flight tests





An LeO 451 with the dorsal gun position with 20-mm. Hispano-Suiza 404 cannon extended. This cannon did not prove as effective a defensive weapon as anticipated

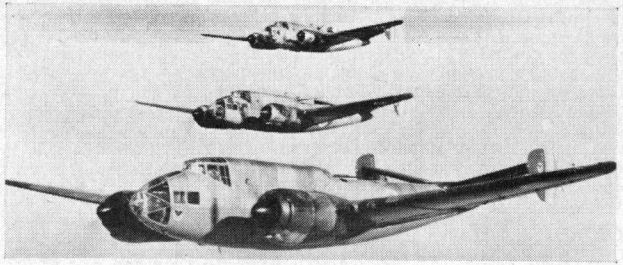
ment. Pilots, in particular, found conversion difficult, having to familiarise themselves with the greater sensitivity of the controls and the poor efficiency of the small vertical control surfaces during the first stages of the take-off run. However, the well-known test pilot, Jacques Lecarme, continuously demonstrated the LeO 451 to service units, and the personnel soon lost their qualms and became enthusiastic over the characteristics of their new mount.

It was not until May 11, 1940 that the LeO 451 dropped its first bombs on the enemy, 12 aircraft from *Groupes de Bombardement* I/12 and II/12 attacking the Maestricht bridges and surrounding roads, one aircraft failing to return from this sortie. GB I/31 undertook its first operational sortie with the LeO 451 four days later, GB II/31 joining operations on the following day; GB I/11 flew its first missions on May 19th, and GB II/11, I/23 and II/23 brought the number of LeO 451-equipped *Groupes* participating in the battle to eight by early June. Owing to the strictly limited numbers of Bre 693s and other aircraft suitable for low-level assault tasks, the LeO 451s, although intended as medium-altitude strategic bombers, had to perform relatively low-level attacks on the advancing enemy columns, usually unescorted, and, as was to be expected, losses were high. One of the few really successful operations of this type was performed on May 16th by 26 LeO 451s from GB I/12, II/12 and I/31 against a *Wehrmacht* division refuelling at Montcornet, but fighter escort was provided and only four of the aircraft were lost. The LeO 451s were rarely so lucky, and the outstanding qualities of the bomber could not be used to advantage on the types of sortie that it was forced to fly, and in 288 day missions flown by the LeO 451 no fewer than 47 aircraft were lost. However, there were occasions when the bomber more than held its own against opposing *Luftwaffe* fighters, and on June 6th *Sergent-Chef* Grandchamp, dorsal gunner in LeO 451 No. 183 of GB I/11, destroyed two Bf 110C fighters in a single sortie.

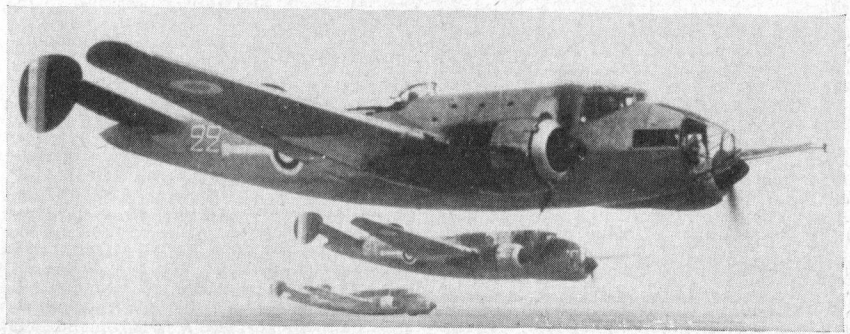
Unfortunately, the 20-mm. Hispano-Suiza 404 cannon on its power-operated SAMM-AB74 mounting in the dorsal position did not prove to be the effective defensive weapon that had been anticipated. Firing was continually interrupted by the necessity to change shell drums, and although the 20-mm. weapon had

an excellent range, *Luftwaffe* fighter pilots quickly learned to get in close, tucking themselves into the blind spot provided by the LeO 451's tail surfaces, throttling back to the speed of the bomber, and attacking in relative safety.

When employed in the strategic night bombing role, the LeO 451 was extremely successful, and losses were low. Various targets in northern Italy suffered nocturnal attacks from the LeO 451, the newly-converted 2e *Escadrille* of GB I/25 taking part in these operations from June 13th, and the longest night attack by LeO 451s took place on June 6th when the BMW plant in Munich was bombed. Palermo was bombed by day on June 23rd by four aircraft from GB II/11 that had taken-off from a North African base, but this was destined to be one of the last operational sorties of the LeO 451 prior to the Armistice.



(*Above and below*) *A trio of LeO 451 bombers of GB I/25 which was retained by the Vichy government and based at Tunis-El Aouina*



DERIVATIVES OF THE LeO 451

A number of modified versions of the LeO 451 and derivatives of the basic design were projected and, in many cases, tested. **LeO 451 No. 51** was experimentally fitted with enlarged vertical tail surfaces of stamped sheet metal construction in place of the standard welded steel-tube structures. This aircraft was flown on March 6, 1940 at Villacoublay, and underwent successful CEMA tests from March 22nd, but the Armistice prevented this modification being introduced on the assembly lines. The SNCAO designed and manufactured a wooden tail assembly for the LeO 451, although this was never flown on an aircraft. One aircraft, **LeO 451 No. 167**, was fitted with dual controls and flown at Villacoublay in the spring of 1940.

LeO 451M: Intended for shore-based operation by the *Aéronavale* and originally designated **LeO 456**, this model differed so little from the LeO 451 of the *Armée de l'Air* that, from November 1939, it was known as the LeO 451M, the "M" suffix indicating *Marine*. The essential difference between the standard LeO 451 and the *Aéronavale*'s LeO 451M was the provision of Bulaira cellular rubber blocks in the outer wing panels and the rear sections of the wing-root fairings. An inflatable flotation bag was installed beneath the navigator's position, a K35 bombsight replaced the Bronzavia D30, and 7.5-mm. Darne machine guns supplanted the MAC 1934 weapons in all positions. Forty-eight aircraft of this type had been ordered for the *Aéronavale* in October 1939, a supplementary order for a further 20 being placed early in 1940, and the LeO 451M No. 1 was delivered to the *Aéronavale* on May 29, 1940. This was destined to be the only example of its type as priority had, in the meantime, been given to production of the standard LeO 451. The aircraft was delivered to a shore-based naval unit, *Escadrille* 1B, which had been formed with LeO 451s intended for the *Armée de l'Air*, but this unit saw no action before the Armistice.

LeO 452: Projected in 1938 as a version of the basic LeO 45 with 14-cylinder Hispano-Suiza two-row radial engines expected to offer improved performance over the HS 14AA engines of the prototype, the LeO 452 was not proceeded with.

LeO 453: Proposals to install Pratt & Whitney R-1830 Twin Wasp engines in the basic LeO 45 airframe under the designation LeO 453 were first made in 1939, although, in the event, no prototype was built prior to June 1940. This designation was destined to be resurrected after World War II, however, when, from mid-1946, the *Atelier Industriel de l'Air* No. 1 at Algiers-Maison Blanche refurbished 40 LeO 451s, simultaneously re-engining them with 1,200 h.p. Pratt & Whitney R-1830-67 Twin Wasps as LeO 453s (Nos. 1 to 40). Numbers 35, 36, 38 and 39 were delivered to the *Aéronavale's Escadrille* 11S in 1951 at Les Mureaux, Nos. 31, 32, 33 and 34 were supplied to the *Institut Géographique National*, and the remainder went to *Armée de l'Air* communications and air-sea rescue units.

LeO 454: A prototype nearing completion at Marignane when work ceased on June 25, 1940 was that of the LeO 454 powered by Bristol Hercules II engines manufactured under licence by SIGMA at Vénissieux, in the outskirts of Lyons. The sole example of the LeO 454 had been ordered in 1939, and two production versions were proposed, one having Hercules II engines with Bristol-designed cowlings and the other having Hercules IIIs with Mercier cowlings.

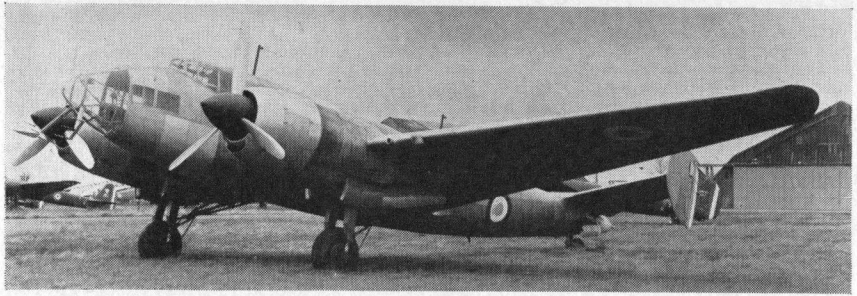
LeO 455: The installation of two Gnôme-Rhône 14R 0/1 14-cylinder two-row radials in an LeO 451 airframe resulted in the **LeO 455-01** which was flown for the first time at Villacoublay on December 3, 1939. The GR 14R was similar to the 14N apart from having two-speed superchargers and all auxiliaries mounted on a separate remotely-driven gearbox, and as installed in the LeO 455-01 this engine offered 1,375 h.p. at 8,530 ft. and 1,230 h.p. at 16,400 ft. The Mercier engine cowlings were retained, and the airscrews were Ratier 1733/1734 units of 12 ft. $1\frac{3}{8}$ in. diameter. As a result of some overheating, these airscrews were supplanted by Ratier 1761/1762 units with modified roots, trials being resumed with these fitted on February 14, 1940. On March 2nd the LeO 455-01 was flown with a ventral fin, and two weeks later was flown from Villacoublay to Marignane for further manufacturer's trials. On May 19th the aircraft was flown with airscrews of reduced diameter, the ventral fin deleted, and similar enlarged vertical tail surfaces to those tested on LeO 451 No. 51, but on August 28th the LeO 455-01 was flown to Istres for storage in a *Dépot de Stockage*.

Following the receipt of authorization to resume flight testing, the LeO 455-01 was fitted with 11 ft $7\frac{1}{3}$ in. diameter Mercier airscrews and ferried to Marignane on May 1, 1942. Shortly afterwards the prototype was modified to take so-called *Groupe Standard* power plants, re-emerging a year later from the workshops under the designation **LeO 451.01GS** (the "GS" suffix indicating *Groupes Standards*) and flying at Marignane on June 19, 1943. The *Groupes Standards* were "power eggs" designed by the SNCASO and built by Bronzavia around Gnôme-Rhône 14R 4/5 radials of 1,320 h.p. at 6,890 ft. and 1,230 h.p. at 19,685 ft. for normal cruising, and it was planned to standardise on these units, installing them in the Breguet 500 commercial transport, the SE 1010 survey aircraft, the second and third SE 200 flying boats, and various other projected aircraft. On the LeO 451.01GS the "power eggs" were attached to elongated mounts which positioned the airscrews 1 ft. 11 in. further forward of the wing leading edge. This necessitated vertical tail surfaces of increased area to counter the yaw instability resulting from the elongated engine nacelles, and five days after the initial flight the aircraft flew with a 13 per cent increase in tailplane chord.

Production orders for the LeO 455 had been placed with the SNCAO in the autumn of 1939, but construction of the **LeO 455 No. 1** had been stopped by the German onslaught. However, the aviation section of the June 1940 *Diktat* had stipulated that the LeO 455 should be delivered to the *Reichsluftfahrtministerium*, and therefore **LeO 451 No. 584** was completed at Marignane as the **LeO 455-02**, and flew on January 22, 1944 sporting the German radio call-sign letters CN+UX. Every effort had been made by the SNCASE personnel to delay completion of the aircraft, and although ostensibly delivered to the *Frontreparaturbetrieb* Nr 61 at Marignane on February 24, 1944, factory trials proceeded extremely slowly, the aircraft not being flown to Germany until April 28, 1944.

After the termination of hostilities, LeO 451 Nos. 499, 500 and 602 were modified as LeO 455s for GR 14R engine development with SNECMA, and five additional aircraft, LeO 451 Nos. 401, 421, 556, 566 and 722, were modified as LeO 455 Ph photographic survey and mapping aircraft for use by the *Institut Géographique National*.

LeO 457: Retaining the wing, tail assembly and undercarriage of the LeO 451, the LeO 457 was projected as a pressurized high-altitude bomber carrying a crew of three (pilot, navigator-bombardier, and radio operator) in a pressure cabin ahead of the wing. The LeO 457 was to be powered by two Hispano-



The LeO 455 No.03 (ex-LeO 451 No.602), initially flown at Marignane on October 22, 1945, and subsequently operated on engine development by SNECMA

Suiza 89ter 12-cylinder liquid-cooled engines driving HS-Hamilton Hydromatic airscrews of 13 ft. 3½ in. diameter, full power being maintained up to an altitude of 29,530 ft. by means of exhaust-driven Brown-Boveri superchargers. Retractable radiators were positioned in the lower fuselage, aft of the rear wing spar, and by comparison with the LeO 451, the fuselage depth was reduced from 7 ft. 10½ in. to 7 ft. 0⅜ in. Defensive armament was to have comprised six rear-firing 7.5-mm. MAC 1934 machine guns with 1,000 r.p.g., and the bomb load was to have comprised five 496-lb. bombs in the fuselage bay and two 496-lb. or 1,102-lb. bombs in bays in the wing roots.

It was anticipated that the LeO 457 would attain a maximum speed of 342 m.p.h. at 29,530 ft., and have an absolute ceiling of 45,930 ft., and five aircraft of this type were ordered on June 5, 1939. Construction of the first LeO 457 was begun at Argenteuil, and in order to hasten trials with the pressure cabin, which was to maintain an equivalent pressure of 8,200 ft. up to an altitude of 32,800 ft., the first example, the **LeO 457.1**, was to have been completed without armament and with Gnôme-Rhône 14N 48/49 radial engines. The LeO 457.1 was 80 per cent complete when German forces reached Argenteuil, but further work was subsequently abandoned.

LeO 458: Retaining the LeO 451 airframe and armament, the LeO 458 was to have been powered by two Wright GR-2600-A5B Cyclone 14 radials rated at 1,600 h.p. for take-off and having a military rating of 1,400 h.p. in high blower at 10,000 ft. The prototype, the **LeO 458.01**, was under construction in the spring of 1940, and by mid-May orders called for 34 **LeO 458.1s,** 45 **LeO 458.2s** and 119 **LeO 458.3s**, the last digit of the designation indicating differences between the batches. For example, the LeO 458.2 was to have had GR-2600-A5B Cyclones with short shafts for Hamilton airscrews, whereas the LeO 458.3 was to have had long-shaft Cyclones for Curtiss airscrews. An order for a further 15 LeO

458.2s and 346 LeO 458.3s was placed on May 26, 1940, by which time the *Aéronavale* was evincing interest in the proposed **LeO 458M**, the naval staff having requested 300 aircraft of this type, although the actual order was never to be placed. The Leo 458.01 was virtually complete in June 1940, but is presumed to have been subsequently destroyed.

LeO 459: The conversion of LeO 451 bombers as unarmed long-range communications aircraft under the designation LeO 459 was proposed after the Armistice in July 1940. It was planned to install a 55 Imp. gal. auxiliary fuel tank in the lower part of the fuselage bomb-bay, and a 138.5 Imp. gal. tank in each of the two wing-root bomb-bays, increasing total fuel capacity to 1,031.5 Imp. gal. and range at economical cruising speed to 2,796 miles. This proposed variant was subsequently re-designated **LeO 451 LC** (*Long Courrier*), but no conversion was completed. A similar conversion was designed in 1943, which, with accommodation for four–six passengers, was to have used the wing-root bomb-bays as freight compartments. This was dubbed **LeO 451C** (*Commercial*), this designation being handed on to two 1943–44 projects employing redesigned fuselages for 14 and 21 passengers. Eventually, the LeO 451C designation was applied to 12 machines hurriedly converted to each carry 12 passengers for Air France.

Three of the LeO 451Cs were eventually further modified as **LeO 451E** ("E" indicating *Essais* or Test) flying laboratory and test-bed aircraft, together with nine other LeO 451s taken over by the *Direction Technique et Industrielle de l'Air*. These were loaned to the SNCASE and ONERA for de-icing trials, control surface research, parachute trials, as control aircraft for tests with BHT radio-controlled bombs, as launching aircraft for SE 1500 series air-to-surface missiles and for numerous other trials.

CAREER SUBSEQUENT TO JUNE 23, 1940

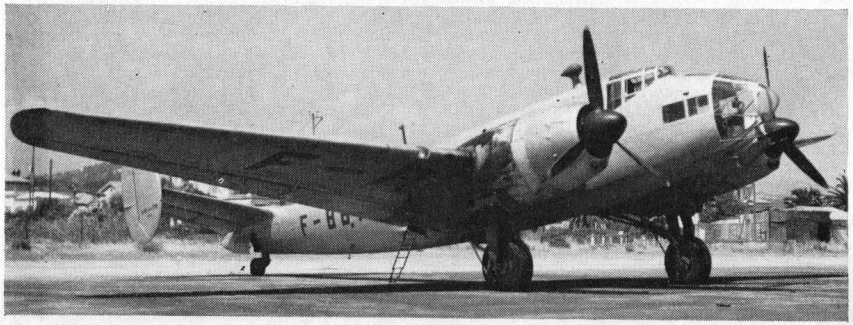
In July 1940, the Armistice Commissions authorized the conversion of the *Groupe de Bombardement* II/25 from ancient LeO H-257bis biplanes to the LeO 451, but GB II/11, II/12 and II/31 were disbanded. *Groupes de Bombardement* I/11, I/12, I/23, II/23, I/25, II/25, and I/31 were retained by the Vichy authorities, however, and continued to operate LeO 451s, two of these units, GB I/12 and I/31, participating in the desultory fighting in the Levant in 1941. The *Aéronavale's* 4e *Flottille*, comprising *Escadrilles* 6B and 7B which had lost all their Martin 167s during the Levant operations, re-equipped with the LeO 451 at Tafaraoui, Algeria, in July 1941, and between May and December 1941, GB I/38 and II/38 converted onto the LeO 451 from the Amiot 143.

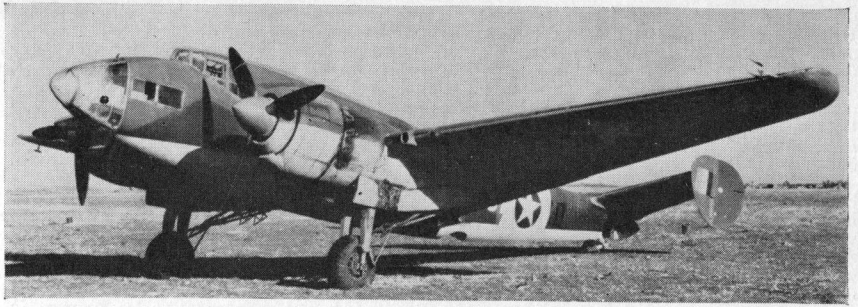
During 1941, all existing LeO 451s had their tail surfaces modified by the fitting of fins and rudders similar to those tested in March 1940 on LeO 451 No. 51, and another change introduced progressively from October 1941 was the replacement of the SAMM-AB26 power-operated dorsal cannon mounting by a SAMM-AB74 mounting which carried two 7.5-mm. MAC 1934 machine guns with 750-r.p.g. in addition to the 20-mm. weapon. Between July 11 and September 11, 1941, bombing attacks in 45° dives were undertaken at Istres, these trials proving particularly successful, and as only minor modifications to the existing bomb racks were called for, all LeO 451 units were instructed to adopt this method of attack. In August, September and October 1941 comparative cooling tests were flown by LeO 451 No. 242 with standard production Mercier engine cowlings and LeO 451 No. 23 with cowlings similar to those fitted to the Bloch 174 in order to ascertain the possibility of standardization. LeO 451 No.

242 was also tested with two-rear-firing 7.5-mm. MAC 1934 M39 belt-fed machine guns on wobble-mounts in the wing-root fairings. This installation underwent firing trials at Istres in October 1941, and it was planned to adopt this as standard but these plans were thwarted by the German occupation of the Vichy zone.

In the meantime, on August 20, 1941, the *Secrétariat d'Etat de l'Aviation* had placed an order with the SNCASE's Ambérieu plant for 225 LeO 451s, these incorporating the tail and dorsal turret modifications being applied retrospectively to existing machines, and having the LMT-RC5b direction finder supplanted by one of SFR-AG222 type, and the Alkan 11 in place of the Smith-Jaeger autopilot. A small number of these aircraft were intended for the *Aéronavale*, and were to differ from those for the *Armée de l'Air* in having OPL-K35 bomb-sights instead of those of Bronzavia D30 type, and bomb racks modified to accept naval bombs. In order to fulfil this order, the SNCASE had to gather together components manufactured in 1940

(*Above and below*) *LeO* 455 *Ph No.*3 (*ex-LeO* 451 *No.*421) *modified for mapping and survey tasks with the French Institut Géographique National*





An LeO 451*T* (*formerly ON-ZD*) *captured from the Luftwaffe and photographed in Sicily in* 1943 *while serving as a squadron hack with the* 57*th Fighter Group, U.S.A.A.F.*

and stored by the various sub-contractors, the German authorities permitting some of these components to be collected from the occupied zone.

The first LeO 451 completed against this 225-aircraft order, LeO 451 No. 453, was flown on April 30, 1942, and under a standardization scheme, it was planned to replace all Martin 167s and Douglas DB-7s with the LeO 451. The Martin 167-equipped *Groupe de Reconnaissance* I/22 received its first LeO 451 on May 24, 1942, and completed conversion late in July, retaining the long-range reconnaissance role, and when the Allies landed in North Africa on November 8, 1942, the LeO 451 strength of the *Armée de l'Air* and *Aéronavale* comprised GB I/11 at Oran, GB I/12 at Istres, GB I/22 at Salé, GB I/23 at Marrakesh, GB II/23 at Meknès, GB I/25 and II/25 at Tunis, and GB I/31, I/38 and II/38 at Istres, plus the 4e *Flottille* at Tafaraoui-Lartigues, each unit having a statutory strength of 13 aircraft.

Groupes I/11 and I/22 lost most of their equipment during Fleet Air Arm and U.S. Navy strafing attacks on Oran and Salé, and GB I/25 and II/25 evacuated the Tunis-El Aouina base, flying to Aïn-Oussera in Algeria, where the latter unit was to be disbanded on December 31, 1942. The remaining LeO 451 units in North Africa were engaged on transport tasks, ferrying U.S.A.A.F. supplies from Moroccan harbours to advanced airfields in Tunisia and eastern Algeria. GB I/25 alone transported 180 tons of ammunition between January 18 and 28, 1943, before reverting to the bombing role as a component of the North-West African Tactical Air Force, performing its first bombing sortie on February 24th with a night attack on Nefta, Tunisia. The other LeO 451 units were also absorbed by the NWATAF, but by the time the Tunisian campaign ended on May 8, 1943, shortages of spares had begun to limit the LeO 451's usefulness, and GB I/11 and I/23 were disbanded during the following months, the personnel

of GB II/23 and I/25 were transferred to the UK for conversion to Halifaxes (as Nos. 346 and 347 Squadrons) and, in September 1943, GB I/22 began conversion to Marauders. The 4e *Flottille* of the *Aéronavale* had also been disbanded on July 1, 1943, and its surviving LeO 451s were, like those of the *Armée de l'Air* units, given over to the communications and training tasks.

In France, GB I/12, I/31, I/38 and II/38 had been disbanded on November 28, 1942 by German order, and their LeO 451s, together with those in storage or awaiting delivery at the Ambérieu plant, were seized by the *Luftwaffe* which thus acquired some 94 aircraft. A number of others were seized by the *Regia Aeronautica*, serving briefly with the 51° *Gruppo Bombardamento Terrestre* in Sardinia and Central Italy, and with the *Reparti Scuola della Specialità Bombardamento*. The *Luftwaffe* was primarily interested in the type for the transportation of fuel and personnel under the designation **LeO 451T**, and early in 1943, LeO 451 Nos. 515 and 546 served as prototype conversions at Marignane.

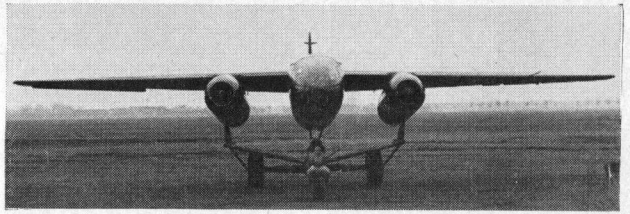
The ventral turret was deleted, the wing-root bomb-bays were converted for the transportation of freight, and provision was made to accommodate 17 troops or eight 44 Imp. gal. fuel drums. Armament of the LeO 451T varied, but a 7.9-mm. MG 81 machine gun was normally fitted on a flexible mounting in the extreme nose, and a similar weapon replaced the 20-mm. cannon in the dorsal position. The conversions were undertaken by the SNCASE at Marignane, and *Kampfgruppe z.b.V.* 700, one of five Ju 52/3m *Gruppen* hurriedly activated in December 1941 in an attempt to alleviate the supply situation on the Russian front, subsequently operating at Demjansk, in the Southern Sector, and Stalingrad, was withdrawn to Le Bourget in the spring of 1943 for conversion to the LeO 451T. Delivery of the conversions proceeded so slowly that K.Gr.z.b.V. 700 had still not completed transition to the LeO 451T by the summer of 1944. Early in 1944, two LeO 451s were also on the strength of 1 Staffel I/*Kampfgeschwader* 200 which employed them for agent dropping and other tasks.

SUD-EST LeO 451 B4 SPECIFICATION

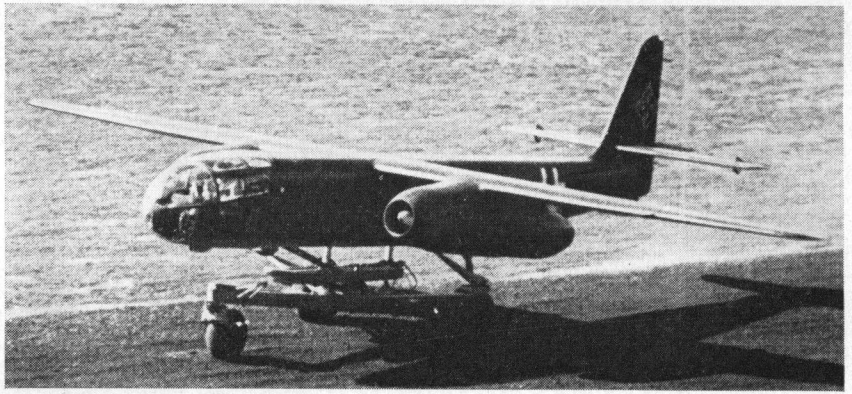
Type: *Four-seat Medium Bomber.* **Power Plants:** *Two Gnôme-Rhône* 14*N* 48/49 *14-cylinder radial air-cooled engines each rated at* 1,140 *h.p. for take-off and* 1,035 *h.p. at* 15,750 *ft.* **Armament:** (*Defensive*) *One fixed forward-firing* 7.5-*mm. MAC* 1934 *M*39 *machine gun with* 300 *rounds, one* 20-*mm. Hispano-Suiza* 404 *cannon with* 120 *rounds in retractable SAMM-AB*26 *power-operated dorsal turret, and one* 7.5-*mm. MAC* 1934 *machine gun with* 500 *rounds in retractable ventral turret.* (*Offensive*) *Two* 1,102-*lb. and five* 441-*lb. bombs in fuselage bomb-bay with* 220 *Imp. gal. of fuel, two* 1,102-*lb. and two* 441-*lb. bombs with* 398 *Imp. gal. fuel, two* 1,102-*lb. bombs with* 530 *Imp. gal. fuel, or one* 1,102-*lb. or two* 441-*lb. bombs with* 712 *Imp. gal. fuel, plus one* 441-*lb. or* 220-*lb. bomb in each of two wing-root bays.* **Performance:** *Maximum speed,* 307 *m.p.h. at* 15,748 *ft.; maximum cruising speed,* 261 *m.p.h. at* 15,748 *ft.; economical cruising speed,* 227 *m.p.h. at* 8,200 *ft.; range with* 1,100-*lb. bomb load,* 1,430 *mls.; time to* 16,400 *ft.,* 14 *min.; service ceiling,* 29,530 *ft.* **Weights:** *Empty,* 17,225 *lb.; normal loaded,* 25,133 *lb.* **Dimensions:** *Span,* 73 *ft.* 10½ *in.; length,* 56 *ft.* 4 *in.; height,* 17 *ft.* 2¼ *in.; wing area,* 731.945 *sq. ft.*

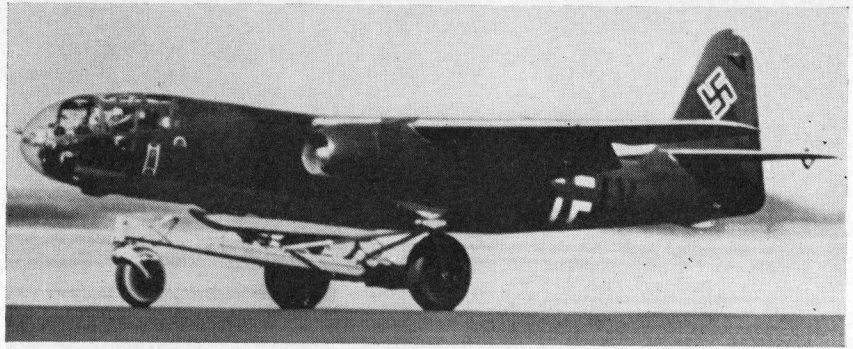
ARADO AR 234 — GERMANY

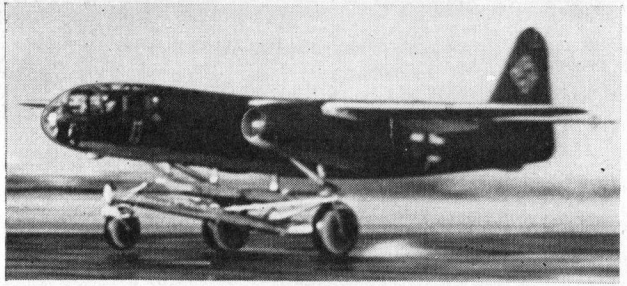
Germany's wartime aircraft industry was responsible for prodigious advances in aeronautical research and development, and none more striking than those concerned with the evolution of turbojet-propelled combat aircraft. Lacking co-ordination and sound high-level directive, however, these advances saw practical application too late to affect to any marked extent the course of the war. Nevertheless, it is a remarkable fact that, at a time when the Allies were cautiously flight testing their first jet fighters, much of the German air-



(*Right and below*) *The Ar* 234 *V*1 *at Rheine during the initial flight test programme*







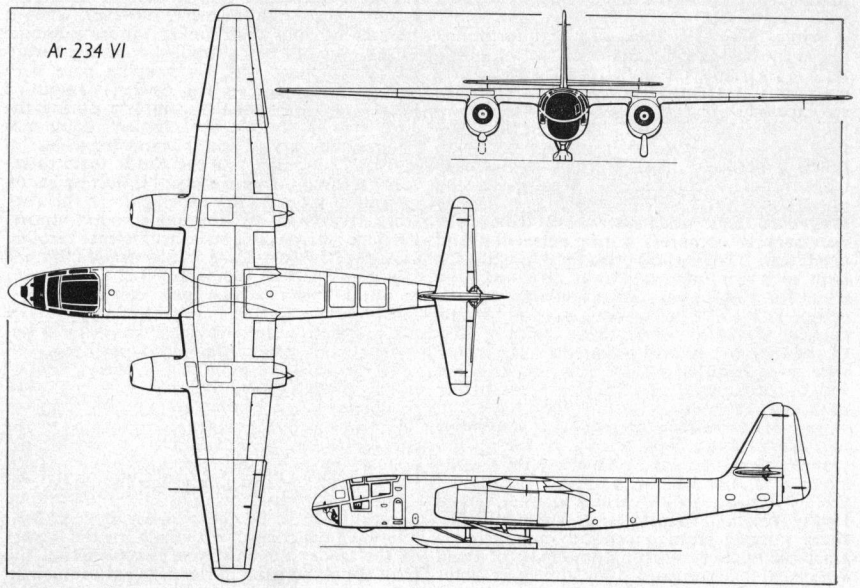
(Above and left) The Ar 234 V1 taking-off on its initial flight. It will be noted that during the initial phase of the take-off (above) the skid struts were under compression but were fully extended as lift-off speed was approached (left)

craft industry's manufacturing potential was already concentrated on the quantity production of turbojet-driven warplanes, one of the most important of which was the Arado Ar 234.

During the late autumn of 1940, Dipl. Ing. Walter Blume and Ing. Rebeski of the Arado Flugzeugwerke initiated studies at the behest of the *Reichsluftfahrtministerium* (RLM) for a medium-range reconnaissance aircraft that was to make use of the new turbojets then being bench-run by BMW and Junkers. It was anticipated that the use of these new and revolutionary power plants would make possible

operational speeds and altitudes sufficient to endow the proposed aircraft with immunity from interception. During the months that followed, several draft proposals were submitted to the RLM, but by the beginning of 1941, one of the most orthodox of these, the E 370, had been selected as it promised rapid airframe development, the basic configuration being frozen shortly afterwards and the designation Ar 234 being allocated to the project.

Basically a single-seat monoplane with a shoulder-mounted wing under which were slung two turbojets, the Ar 234 was of clean and simple aerodynamic design. The fuselage was a stressed-skin semi-monocoque with flat 'top-hat' section longerons and 'Z' section formers and stringers. The two-spar stressed-skin wing rested on a reinforced box-girder section of the fuselage, being bolted to the upper longerons at four points. The pilot's cockpit, which was extensively glazed and pressurized by air tapped from the turbojet compressors, occupied



the extreme nose of the fuselage, and aft of the cockpit the bulk of the fuselage was given over to fuel tanks. The wing featured dual taper on the leading edge, its trailing edge carrying Frise ailerons of exceptionally narrow chord with mass-balanced gear tabs fitted to the inboard ends adjacent to the large, hydraulically-operated plain hinged two-section flaps. The turbojets were completely underslung, and were suspended from three points, two on the front spar and one on the rear, the lower mainplane surface above the turbojets being covered with steel sheet.

While there was little of the unorthodox about the basic design and construction of the Ar 234 airframe, the undercarriage of the aircraft was extremely novel. Undercarriage stowage had presented a major problem from the outset of design work. The thin, shoulder-mounted wing provided insufficient space to house mainwheel legs and their actuating mechanisms. In any case, the high positioning of the wing would have demanded inordinately long oleo legs which it would have been necessary to compress during retraction and extension. The fuselage cross section had been kept to a minimum and thus provided little room for a space-consuming undercarriage of orthodox type. Furthermore, such an undercarriage would have been heavy, and in view of the quantity of fuel dictated by the 1,340-mile range stipulated by the RLM, strict weight-consciousness had been exercised from the outset of design.

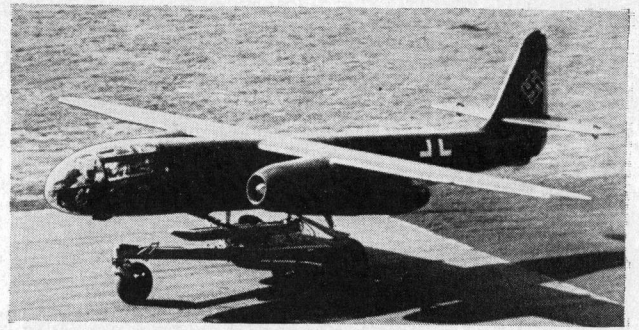
Several unorthodox approaches to the undercarriage problem were made by the Arado team at the earliest design stage, and the RLM's *Technische Amt* had been offered variants of the E 370 project with various alternative and highly original landing gear arrangements, these ranging from a centrally-mounted retractable bogie comprising nine pairs of small wheels and accompanied by outrigger skids retracting into the engine nacelles, to a jettisonable take-off trolley with a centrally-mounted main skid plus outrigger skids for landing. Surprisingly, the *Technische Amt* elected to adopt this last somewhat unlikely arrangement.

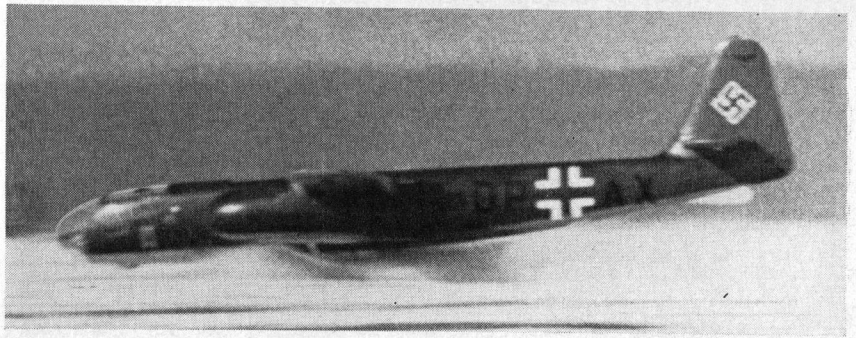
ARADO AR 234A

Prototype construction began during the spring of 1941, and it was anticipated that the first Jumo 004A turbojets would be available for trial installation in the **Ar 234 V1** towards the end of the year. The development programme was soon set awry, however, when it became obvious that Junkers' more sanguine hopes were not being fulfilled, and that turbojet development was not keeping pace with that of the airframe. The Ar 234 V1 and V2 airframes were virtually complete during the early winter of 1941, but Junkers could not promise delivery of power plants for at least a further 12 months, and the Arado team therefore explored the possibility of installing piston engines as a temporary expedient. In this they were frustrated by the unorthodox undercarriage arrangement, insufficient ground clearance for airscrews being offered by the landing skids, and there was no alternative but to await delivery of the turbojets.

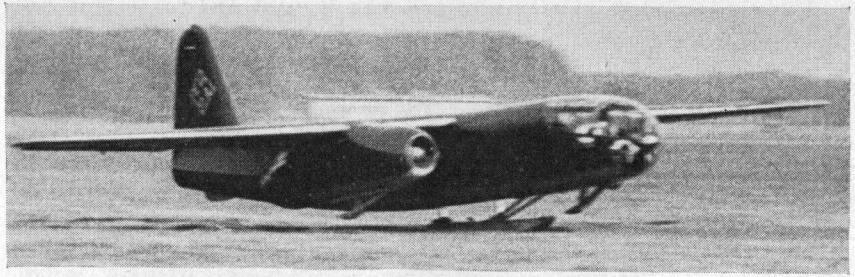
Eventually, during February 1943, a pair of pre-production Jumo 004A engines were delivered to Warnemünde, although these were only intended for static tests, Messerschmitt having priority in the delivery of flight-cleared turbojets. These engines were mounted in the Ar 234 V1 airframe (GK-IV) for taxying trials, these being somewhat lengthy owing to the erratic behaviour of the 1,325-lb. take-off trolley. This featured a steerable nosewheel, and the mainwheels were fitted with hydraulic brakes operated by the pilot's rudder pedals, a lever in the cockpit providing for the release of the trolley which it was intended that the pilot should jettison at the moment of unstick.

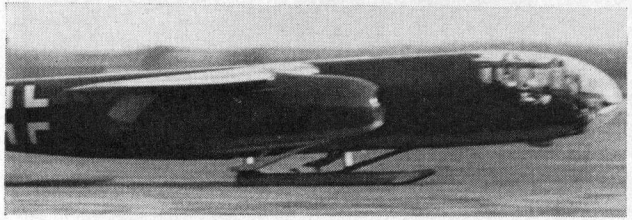
An electrically-actuated emergency trolley-release system was also provided. Quick-release fasteners on the hydraulic brake leads were automatically disconnected as the trolley parted company with the aircraft, a braking chute being deployed to bring the trolley to a standstill. It was decided that, until this release system had been perfected, initial flight tests would be made with the trolley attached for take-off, the pilot subsequently jettisoning this at an altitude of several hundred feet, the trolley being lowered to the ground by means



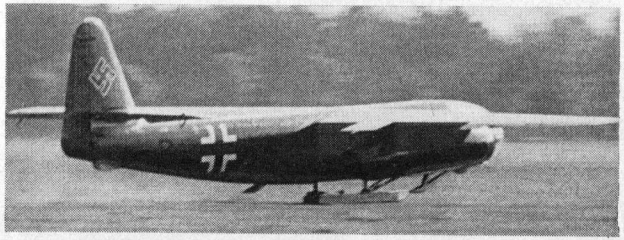


(Right) The Ar 234 V2 on its take-off trolley, and (below) the V2 making a skid-landing on a foam carpet at Rheine





(Above and below) The Ar 234 V3 landing on its skids at Rheine during an early phase of the test programme



of five parachutes.

The Ar 234 V1 was disassembled in the spring of 1943, and transported to Rheine airfield, north of Münster, in Westphalia, for initial flight trials. At Rheine, flight-cleared Jumo 004A engines were substituted for the original units, and after further taxying, which was protracted by some oscillation of the trolley nosewheel as take-off speeds were approached, the aircraft flew for the first time on June 15, 1943 with *Flugkapitän* Selle at the controls.

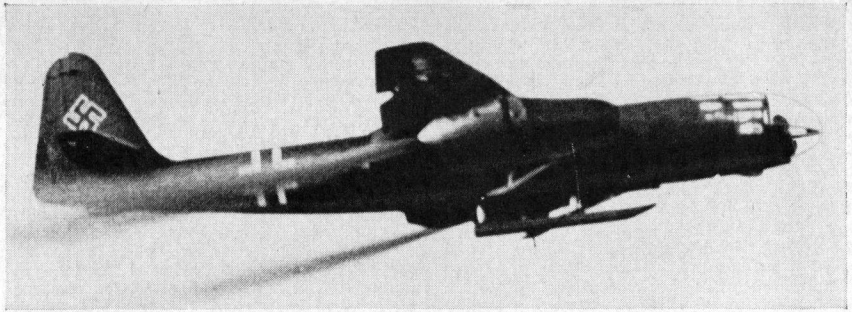
Selle's pre-flight briefing called for jettisoning the take-off trolley once an altitude of 200 ft. had been attained. The release system functioned successfully, but the chutes intended to lower the trolley to the ground failed to deploy, and this was destroyed when it hit the runway. Apart from this mishap, the initial flight was entirely successful, Selle reporting extremely pleasant flying characteristics. A replacement trolley was hurriedly flown to Rheine, but the second flight of the Ar 234 V1 was a repetition of the first insofar as the trolley was concerned as this was again destroyed. On subsequent flights the trolley was released on the runway as soon as flying speed was attained. Some difficulties were encountered with the hydraulic retraction mechanism for the skids which were extended prior to take-off to provide the supports on which the aircraft rested on the trolley. On occasions the skids refused to retract, and during landing there was a tendency for one or other of the outboard skid oleo legs to subside slowly until a wingtip was ploughing up the ground.

The second prototype, the **Ar 234 V2** (DP-AX), joined the V1 at Rheine in July 1943, flying on the 27th of that month, and four weeks later, on August 25th, the **Ar 234 V3** (DP-AW) was flown. Whereas the first two prototypes were, to all intents and purposes, identical, the V3 was intended initially as a production prototype for the planned Ar 234A, and featured an ejection seat for the pilot, cabin pressurization, and provision for the attachment of two *Rauchgeräte* (take-off assistance rocket) units outboard of the engine nacelles. At this time it was anticipated that the production Ar 234A would have an empty weight of 10,580 lb., would carry 6,615 lb. of fuel, and would weigh 17,640 lb. fully loaded. It was anticipated that maximum speed would be 485 m.p.h. at 19,685 ft., maximum operational altitude being 36,090 ft. and range being 1,240 miles.

The **Ar 234 V4**, which joined the test programme in September 1943, differed from its immediate predecessor only in certain items of test equipment, but the **Ar 234 V5** was the first prototype to receive the improved Jumo 004B-0 turbojet, this initially possessing a similar rating to the Jumo 004A at 1,850 lb.s.t., but offering a 200 lb. decrease in engine weight. The V5 had no provision for cabin pressurization, and was concerned with both engine development and an investigation of compressibility effects, but by this time the decision had already been taken by the *Technische Amt* to abandon the proposed A-series in favour of an appreciably more versatile derivative of the design, the Ar 234B, which was dubbed the *Blitz* (Lightning).

One of the major drawbacks of the Ar 234A from the operational viewpoint was the fact that, after landing, the aircraft was unable to manoeuvre on its skids, having to be raised by three spiral jacks onto the take-off trolley for towing to dispersal. It was forseen that landing areas could well be cluttered with immobile aircraft awaiting towing and, in the meantime, extremely vulnerable should the airfield be strafed by enemy intruders. It had become obvious, therefore, that although the trolley-and-skid scheme functioned quite efficiently, a more orthodox undercarriage was necessary, and the Arado team had undertaken some redesign to provide space for such landing gear. This space had been obtained by increasing the fuselage cross section marginally and utilizing much of the bay formed by the central fuselage box girder for wheel wells, the fore and aft fuselage fuel tanks being enlarged to compensate for the loss of fuel capacity that would otherwise have resulted from the deletion of the central fuel cell.

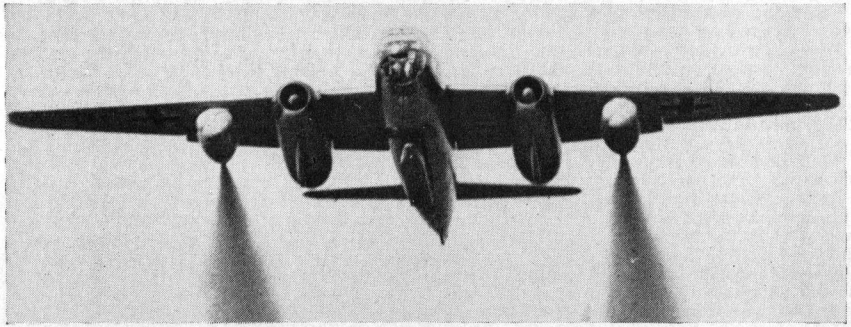
Fitted with large, low-pressure tyres, the main members were single-wheel units retracting forwards and inwards hydraulically



by a simple but robust mechanism, and being enclosed by hydraulically-actuated doors. The heavy nosewheel fork was attached to the fuselage beneath the pilot's seat at a point slightly forward of the wheel axis, and retracted aft.

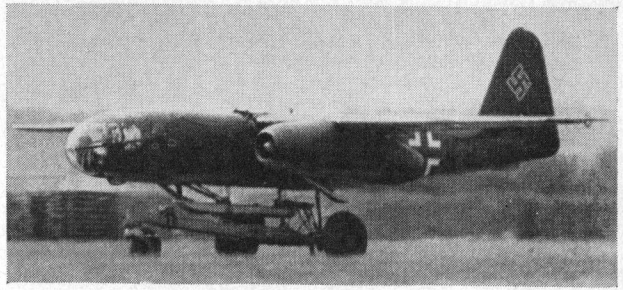
An assembly line for the Ar 234B was set up at Alt Lönnewitz in Saxony late in 1943, and construction of the B-series prototypes and the pre-production Ar 234B-0 reconnaissance aircraft proceeded in parallel, less than 10 weeks

(Above and below) The Ar 234 *V3, which featured ejection seat and cabin pressurization, taking-off with the aid of two Rauchgeräte outboard of the turbojets*



elapsing between the first flight of the first B-series prototype, the Ar 234 V9, in March 1944, and the first pre-production Ar 234B-0 early in the following June. In the meantime, it had been decided to complete the remaining three A-series prototypes as development aircraft for later models, the Ar 234 V6 and V8 being selected for the development of a definitive power plant arrangement for the four-engined Ar 234C, and the **Ar 234 V7** being fitted with production Jumo 004B-1 engines as part of the development programme of these units for the Ar 234B. The fact that these aircraft had A-series airframes necessitated the retention of the trolley-and-skid arrangement. The Ar 234 V7's test career was destined to be singularly short-lived, *Flugkapitän* Selle experiencing a sudden fire in the port engine which burned through the control rods while the aircraft was in the landing circuit, and losing his life, his place being taken as chief test pilot and superintendent of the Alt Lönnewitz flight test division by *Flugkapitän* Joachim Carl.

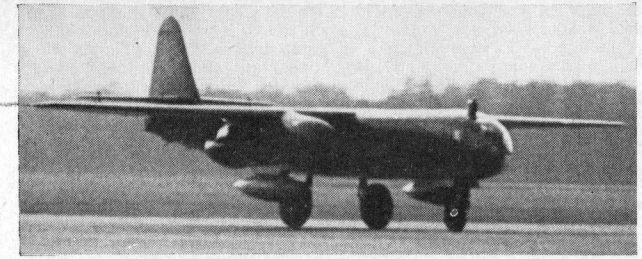
The Ar 234 *V5 under test with a modified take-off trolley lacking the outboard skid rests*



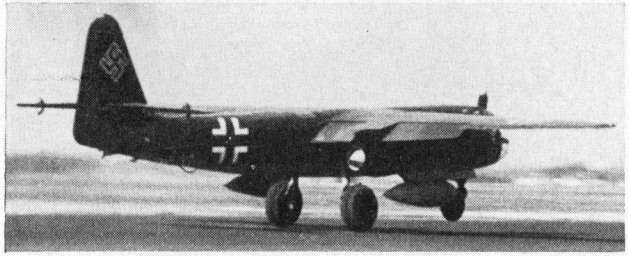
ARADO AR 234B BLITZ

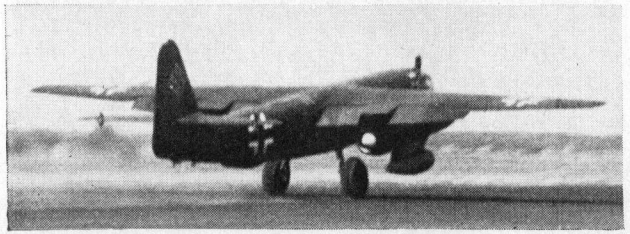
The first B-series prototype, the **Ar 234 V9** (PH-SP) was flown in March 1944, this having Jumo 004B-1 engines, an ejector seat and cockpit pressurization. The **Ar 234 V10** (PH-SQ), which followed in April, differed initially only in having no provision for cabin pressurization, but early in its test programme this prototype was fitted with the B2A periscopic bomb sight for use in glide and shallow dive-bombing trials. Bomb shackles were provided beneath the engine nacelles for 550-lb. or 1,100-lb. bombs or 66 Imp. gal. drop tanks, and attachment points were introduced for *Rauchgeräte* units. The **Ar 234 V11** (PH-SR) was similar to the V9, having a pressurized cockpit and joining the test programme early in May, the next aircraft to fly being the first pre-production **Ar 234B-0** which flew at Alt Lönnewitz on June 8, 1944, two days after the D-Day landings in Normandy, with *Flugkapitän* Carl at the controls.

This first flight of the first pre-production aircraft was scheduled to be witnessed by high-ranking officials from the RLM, the Party and the *Luftwaffe*, but Carl decided that it would be wiser to make an *unofficial* first flight earlier in the day. After taking-off, the "undercarriage up" lights failed to come on, and as the radio failed simultaneously, Carl had no means of



(*Above and below*) *The Ar* 234 *V*9, *the first B-series prototype taking off with auxiliary fuel tanks*





ascertaining if the undercarriage was up or locked in the down position. Nevertheless, he decided to risk landing back at Alt Lönnewitz, and during the final approach both engines flamed out. He succeeded in getting the aircraft down safely, the troubles were traced to faulty micro-switches in the undercarriage retraction mechanism and incorrectly positioned fuel pumps, and five hours later the *official* first flight took place.

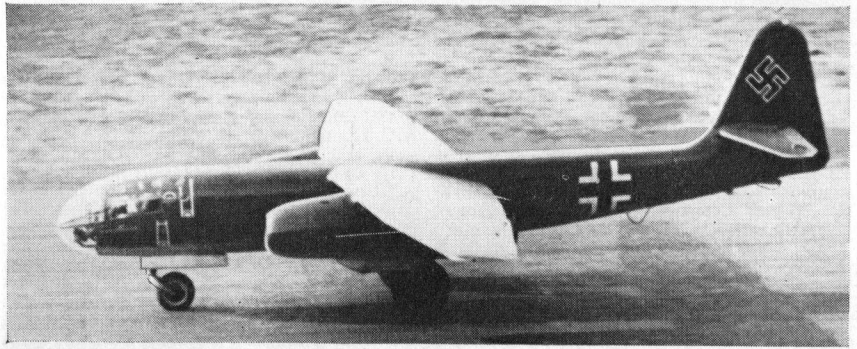
The pre-production Ar 234B-0 was not equipped with ejection seat or cabin pressurizing equipment, but provision was made for the installation of a pair of RB 50/30 or 75/30 reconnaissance cameras or a combination of one RB 75/30 and one RB 20/30. Thirteen of the 20 pre-production aircraft were sent to the *Erprobungstelle* Rechlin the RLM's flight test centre, to participate in an intensive flight development and evaluation programme, and one pilot, Ubbo Janssen, claimed to have attained a speed of Mach 0.86, although it

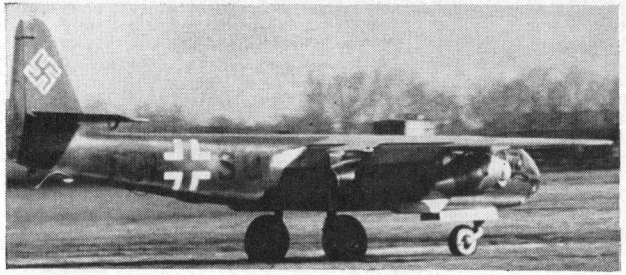
is likely that there was an error in the Machmeter as compressibility effects normally began to manifest themselves in the vicinity of Mach 0.78.

For the initial test programme K1 diesel oil had been used as fuel for the Jumo turbojets, but shortages of K1 necessitated switching to the cheaper and more readily available J2 of the same calorific value. The turbines were activated by Riedel two-cylinder starter motors which ran them up to 3,000 revolutions at which the combustion chambers were electrically ignited. Petrol was used for starting purposes, and at 6,000 revolutions the pilot operated the throttle and the petrol supply was automatically replaced by J2. All fuel was housed in two flexible fuselage tanks, the forward tank, between the pilot's cockpit and the wing leading edge, being of 396 Imp. gal. capacity, and the aft tank containing 440 Imp. gal.

The pre-production Ar 234B-0 was followed off the Alt Lönnewitz assembly line by the **Ar 234B-1** which was essentially similar apart from being equipped with a *Patin PDS* three-axes automatic pilot and having provision for drop tanks as standard, but the Ar 234B-1, which was intended solely for reconnaissance, was an interim model pending the introduction of the very much more versatile **Ar 234B-2** which was suitable for bombing and pathfinding roles as well as that of photographic reconnaissance. The Ar 234B-2s left the Alt Lönnewitz line to various equipment standards, these being indicated by suffix letters. For example, the Ar 234B-2/b was equipped for photo-reconnaissance missions with two RB 50/30 or 75/30 cameras or a single RB 75/30 and an RB 20/30, while the Ar 234B-2/1 was equipped with a *Lotfe* 7K bomb sight for the pathfinder role. If *Patin PDS* equipment was installed the letter "p" was added to the

The second prototype for the B-series, the Ar 234 *V*10, *appeared in April* 1944 *and was later used for bombing trials*





(Left) The Ar 234 V10 taxiing with Rauchgeräte outboard of the engine nacelles and bombs beneath the fuselage and engine nacelles. (Below left) The Ar 234 V10 under test with Rauchgeräte but without bombs

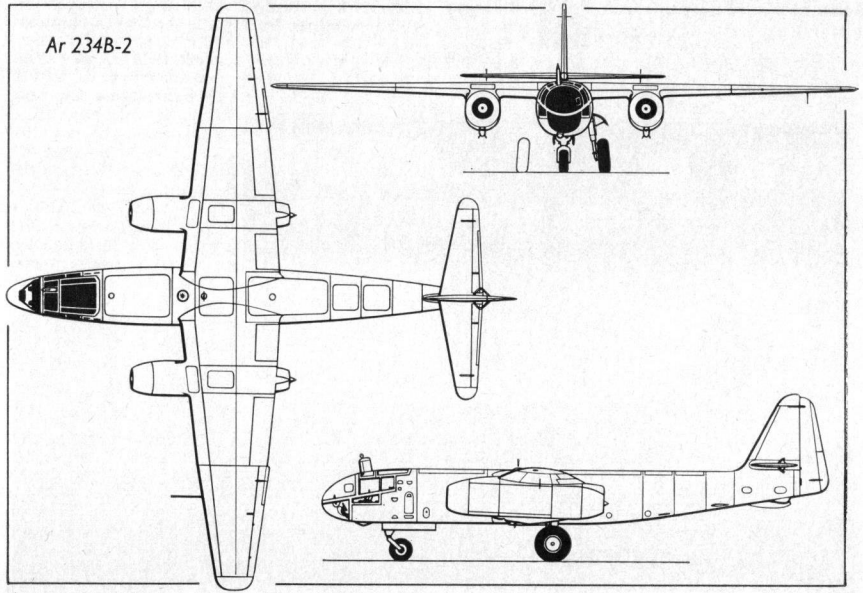
designation, while provision for long-range drop tanks resulted in the addition of the letter "r". Thus, reconnaissance and pathfinder versions embodying both the *Patin PDS* and drop rank attachment points became the Ar 234B-2/bpr and -2/1pr respectively, while the standard bombing model became the Ar 234B-2/p, -2/r or -2/pr according to the equipment installed.

The Ar 234B-2 was intended to carry a 3,300-lb. bomb load in maximum loaded condition, this comprising one 1,100-lb. SC 500J bomb beneath the fuselage and a similar weapon beneath each engine nacelle, but alternative loads included a single 3,086-lb. PC 1400 bomb or 2,205-lb. SD 1000 bomb beneath the fuselage, or a single SC 500J and two 550-lb. SC 250J bombs. A pair of aft-firing 20-mm. MG 151 cannon were mounted by some aircraft, and the PV1B sighting head of the RF2C periscope which was normally used in conjunction with the BZA 1 bombing computer could be turned to provide rearward vision for firing the cannon. The *Lotfe* 7K tachometric bomb sight which was located between the pilot's feet for level bombing enabled a high degree of accuracy to be attained under good conditions. An over-riding control for the automatic pilot was normally employed with this sight during the bombing run, the pilot

disconnecting the control column which then swung clear of the bomb sight, being reconnected when the bombs had been released. For glide and shallow dive-bombing the BZA 1 computer fed the PV1B sighting head with the bombing angle by an electrical remote control system. The only protective armour installed comprised a 15.5-mm. plate attached to the rear wall of the cockpit to provide the pilot's head and shoulders with some protection.

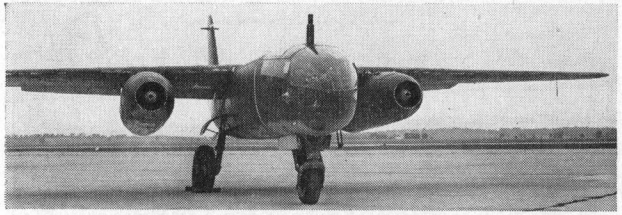
OPERATIONAL CAREER

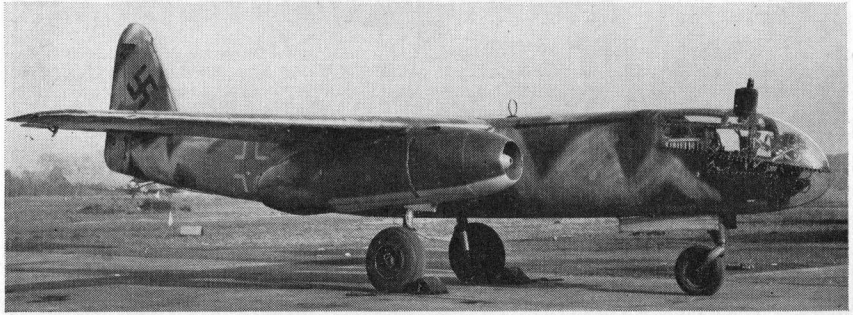
In late September 1944, a *Sonderkommando* was formed in N. W. Germany with Ar 234B-1 reconnaissance aircraft with the immediate task of covering British harbours on the East Coast, between the Thames Estuary and Yarmouth, plus airfields in South-East England, the objective being to provide the German High Command with prior warning of any sign of an Allied invasion of the Nether-



lands. Operating at considerable altitudes and speeds, these aircraft flew with impunity over the British coast. This *Sonderkommando* was formed from 1 *Staffel* of the *Versuchsverbänd Ob.d.L.* which was concerned with testing the latest combat aircraft under operational conditions, and which, by the end of November, had seven Ar 234Bs on strength, 3 *Staffel* having four Ar 234Bs. Previously, 1 *Staffel* had operated the four-engined Ar 234 V6 and V8 for a brief period during which a number of reconnaissance missions were flown with these aircraft.

In November 1944, two other Ar 234B-1-equipped *Sonderkommandos*, the Sd. Kdo. Hecht and the Sd.Kdo.Sperling, were formed for reconnaissance tasks, but in the previous month the first Ar 234B-2 bombers had been delivered to the *Stabs-Staffel* of *Kampfgeschwader* 76, the pilots receiving conversion training at a unit established at Alt Lönnewitz. The first *Gruppe* to commence conversion to the Ar 234B-2 was II/KG 76 in November, and operating from Achmer and Rheine, this unit undertook a number of pinpoint attacks on Allied positions during the Ardennes counter-



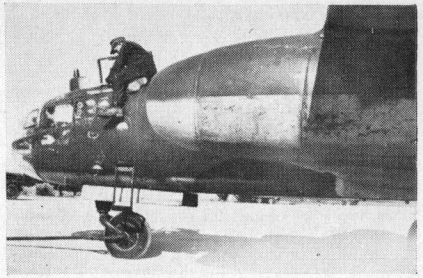


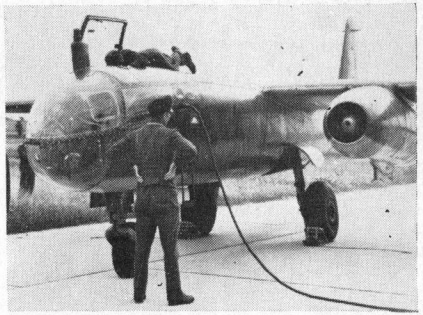
(*Left and below*) *The production Ar* 234*B*-1/*b reconnaissance aircraft*

offensive in December 1944-January 1945. In January 1945, I/KG 76 was also working up to operational status, being followed by III/KG 76, although neither *Gruppe* was destined ever to attain full strength.

The *Sonderkommandos* Hecht and Sperling had been disbanded by the end of 1944, but in January 1945, 1.(F)/100, a long-range reconnaissance *Staffel*, was operating a combination of Ar 234B-1s and Me 262As in Southern Germany under *Luftflotte* 6. The Ar 234B-2s of III/KG 76 were assigned to *Luftflotte West* under *Jagdkorps II*, but flying activities were restricted owing to the severe fuel shortages. However, on February 24th, an Ar 234B-2 from this unit suffered a flame-out in one engine and was forced down by P-47 Thunderbolts near the village of Segelsdorf. On the following day the village was captured by the 9th Army and, with it, the first example of the *Blitz* to fall virtually intact into Allied hands. Early in March, improvements in fuel supplies enabled the Ar 234B-2s of III/KG 76 to increase operational missions up to some 50 per day, most of these being directed against Allied river crossings and spearheads. Between March 7th when it was captured by the Allies and March 17th when it finally collapsed, the Remagen Bridge was continuously attacked by Ar 234s of III/KG 76 carrying 2,205-lb. bombs, these operating in concert with Me 262As which strafed surrounding flak emplacements.

In the spring of 1945, as a result of constant complaints concerning the inadequacy of aerial reconnaissance reports made by German forces in northern Italy, the *Sonderkommando* Sommer was activated with three Ar 234Bs at Udine, North-West of Trieste. The arrival of these aircraft radically changed the situation for, operating at altitudes between 29,500 and 39,000 ft., they maintained regular reconnaissance over the Ancona and Leghorn sectors of the front, and had the situation developed

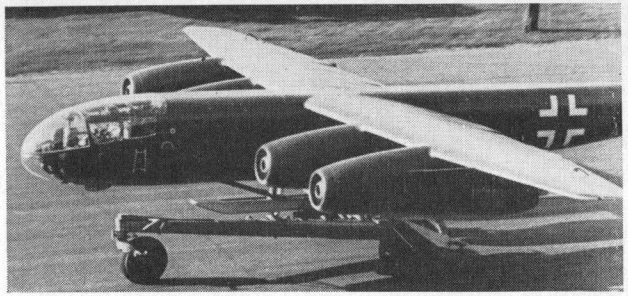




(*Above and below*) *Ar* 234*B*-2/1p *Blitz bomber being serviced*

differently it was proposed to raise the *Sonderkommando* in the Italian theatre to full *Staffel* strength.

By the end of March 1944, all surviving Ar 234B-2s of III/KG 76 had been gathered at Marx, Oldenburg, where they were virtually immobilized, and KG 76's other *Gruppen* were



in no better situation, their remnants being gathered on airfields in Schleswig-Holstein, I/KG 76 being at Leck, II/KG 76 being at Scheppern, and the *Stabs-Staffel* being at Karstädt. The Ar 234Bs of 1. (F)/100 ended the war at Saalbach. A total of 210 Ar 234Bs had been completed at Alt Lönnewitz when production was finally halted, but owing to fuel

(Above and below) The Ar 234 *V6 was an A-series airframe employed in the development programme for the Ar* 234*C. This aircraft did, in fact, fly several operational reconnaissance missions*

ARADO AR 234B-2 BLITZ SPECIFICATION

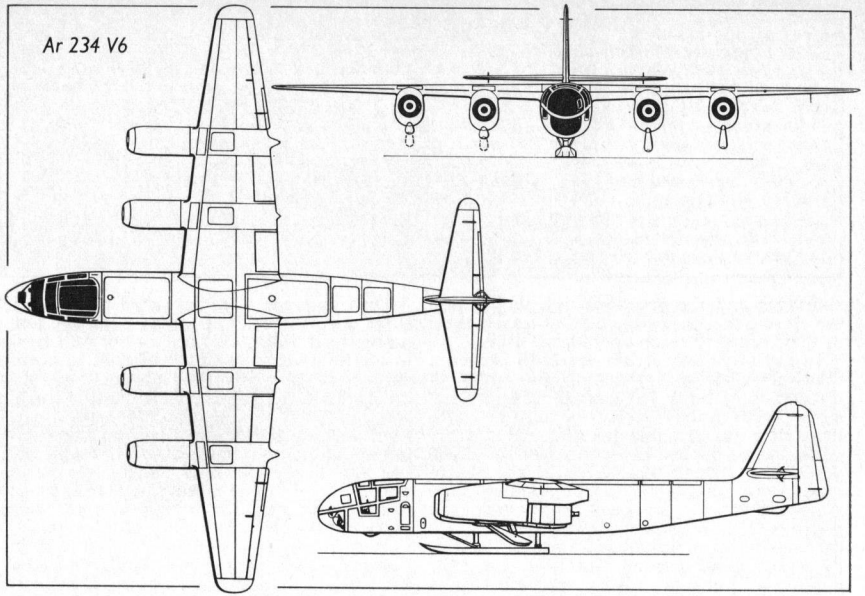
Type: *Single-seat Reconnaissance-Bomber.* **Power Plants:** *Two Junkers Jumo* 004*B Orkan axial-flow turbojets each rated at* 1,980 *lb.s.t.* **Armament:** (*Defensive*) *Two fixed aft-firing* 20-*mm. MG* 151 *cannon with* 200 *r.p.g.* (*Offensive*) *Three* 1,100-*lb. SC* 500*J or SD* 500 *bombs, one* 2,205-*lb. SC* 1000 *or SD* 1000 *bomb and two* 550-*lb. SC* 250*J bombs, one* 3,086-*lb. PC* 1400 *bomb, or three AB* 250 *or* 500 *anti-personnel bomb clusters.* **Performance:** (*Without external load*) *Maximum speed,* 461 *m.p.h. at* 19,685 *ft.,* 460 *m.p.h. at* 26,250 *ft.,* 435 *m.p.h. at* 32,800 *ft.; maximum range* (*clean*), 1,013 *mls.,* (*with* 1,100-*lb. bomb load*) 967 *mls.,* (*with* 3,300-*lb. bomb load*), 684 *mls.; climb* (*with* 1,100 *lb. bomb load*) *to* 19,685 *ft.* 12.8 *min., to* 26,250 *ft.,* 21.6 min., (*with* 3,300-*lb. bomb load*), *to* 19,685 *ft.,* 17.5 *min., to* 26,250 *ft.,* 34.1 *min.; service ceiling,* 32,810 *ft.* **Weights:** *Empty,* 11,464 *lb.; loaded* (*clean*), 18,541 *lb.; maximum loaded,* 21,715 *lb.* **Dimensions:** *Span,* 46 *ft.* 3½ *in.; length,* 41 *ft.* 5½ *in.; height,* 14 *ft.* 1¼ *in.; wing area,* 284.167 *sq. ft.*

shortages and the confusion reigning during the closing months of the war, at least a third of these failed to reach operational units.

In *Luftwaffe* service, the Ar 234B proved a relatively pleasant aircraft to fly, although directional stability left something to be desired. Without the *Rauchgeräte* units and with half-full tanks, it could take-off within 1,100 yards but demanded between 2,000 and 2,200 yards fully laden. The shape of the sharp-nosed Frise ailerons had been determined in the Aldershof wind tunnel, although these did not prove entirely satisfactory in service. Unless extreme care was exercised in rigging and in adjusting hinge shroud distances, etc., the ailerons misbehaved violently at speeds greater than 370 m.p.h., and a common fault was rapid oscillation accompanied by the stick threshing from side to side. Sometimes as many as 10 flights were demanded by each production aircraft before the ailerons were adjusted correctly. On prototypes where the fin and rudder were hand made no bad directional unsteadiness was experienced, but on production aircraft the fin profile rarely carried on smoothly to the rudder, resulting in decidedly poor directional stability.

Diving speeds were restricted owing to jet surge and sensitivity of lateral trim, the latter rendering it difficult for a pilot not well versed in the idiosyncracies of the aircraft to keep it straight in dives. Normal production testing involved a dive from 10,000 ft. up to a true air speed of 530 m.p.h., and no Mach effects were noticeable on longitudinal trim at this speed, but above 560 m.p.h. the aircraft became nose heavy and the elevators sloppy. In "over-pulled" condition, the aircraft simply stalled through, the nose dropping and speed being picked up. A spin following a stall lasted for only one full turn, and the aircraft was immediately fully controllable again. All aerobatic maneouvres could be executed, and the landing approach speed (at 13,200 lb.) with 25° flap was of the order of 155 m.p.h., decreasing to 130 m.p.h. with 45° flap at which stalling speed was about 110 m.p.h. The lowering of the undercarriage and flaps had very little effect on trim, and a baulked landing with undercarriage and flaps down presented no difficulties as the forces could easily be held with one hand whilst retrimming with the other.

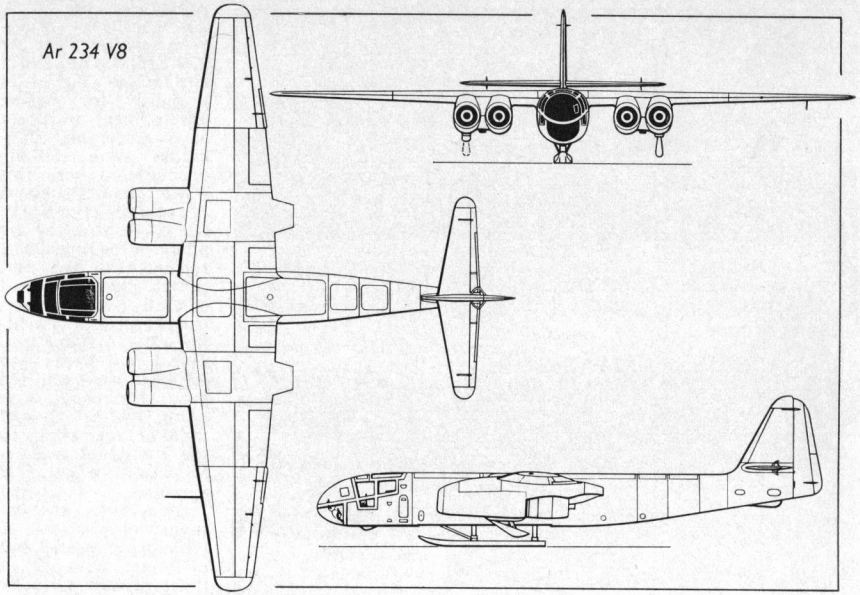
The Ar 234B was very stable on landing and



unaffected by normal cross winds, but at least 1,100 yards were required for the landing run with the brakes held on continuously. In consequence, the brakes were frequently burned out after two or three landings. It was not difficult to relight one of the Jumo 004Bs after a flame out at altitudes below 13,000 ft. and at speeds between 250 and 310 m.p.h., but above this altitude and at higher speeds a relight was impossible. In the event of a flame out at higher altitudes the pilot had to close the fuel cock immediately as, failing to do so, resulted in flooding the engine which was usually followed by a fire.

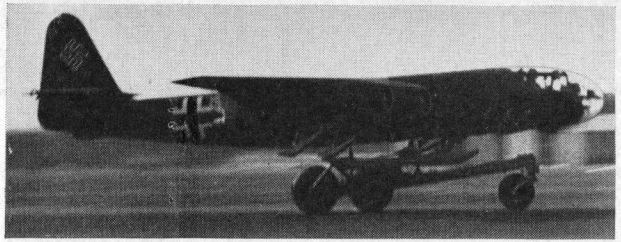
ARADO AR 234C

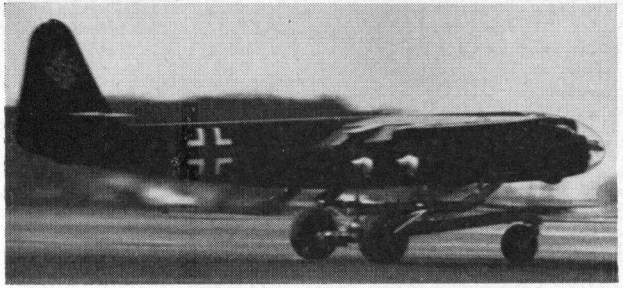
At an early stage in the development of the *Blitz* it had become obvious that the basic airframe could absorb substantially more power than that provided by a pair of Jumo 004Bs,

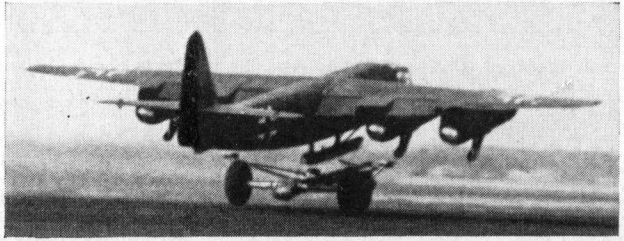


and a further derivative was proposed, this, the Ar 234C, utilizing four of the smaller and lighter BMW 003A turbojets. In order to arrive at a definitive engine arrangement, two A-series prototypes were adapted to take four BMW 003A-0 turbojets, the first of these to fly being the **Ar 234 V8** (GK-IY) which began trials in February 1944, followed two months later by the **Ar 234 V6** (GK-IW). Whereas the V8 had four individual and widely spaced turbojet nacelles, the V6 had its engines paired in two nacelles, this arrangement subsequently proving the most efficient and being adopted for the C-series.

A B-series prototype, the **Ar 234 V13,** was fitted with four production BMW 003A-1 turbojets to participate in the Ar 234C development programme, this being readied for flight testing at the end of August 1944, one month before the début of the first genuine Ar 234C



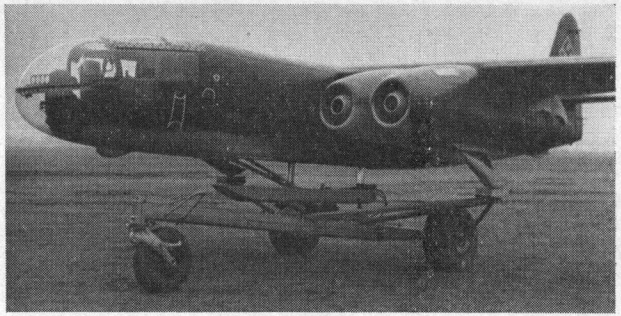


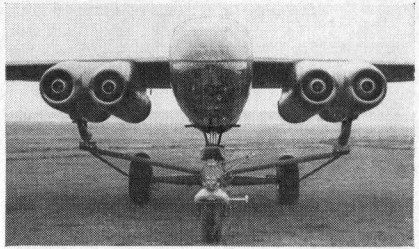


(Left, top to bottom) The Ar 234 V6 taking-off and jettisoning its trolley

prototype, the **V19.** Another B-series prototype airframe, the **Ar 234 V15,** was fitted with two BMW 003 A-1s primarily for engine development purposes as considerable difficulties were initially encountered with this power plant. Problems of regulating the BMW 003 were resolved by adapting the Jumo 004B regulator to the new power plant, but not so easily overcome was the problem of relighting after a flame out. Petrol had been used for fuel throughout the entire test programme of the BMW 003, and it did not take kindly to the use of J2 necessitated by the general fuel situation that existed by mid-1944. For starting petrol was used, as with the Jumo 004B, but a relight with J2 in flight proved virtually

(Right and below right) The Ar 234 V8 which served to provide the definitive engine arrangement for the Ar 234C series of aircraft

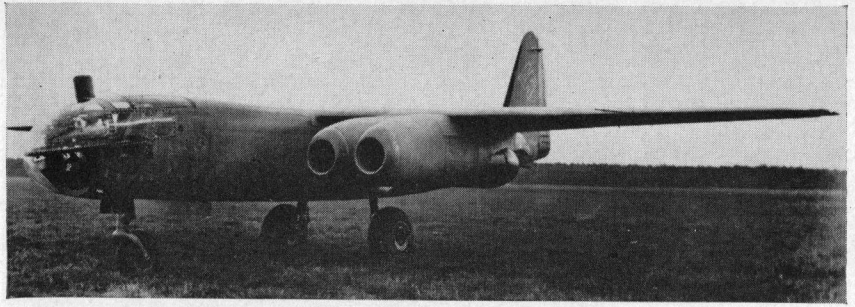




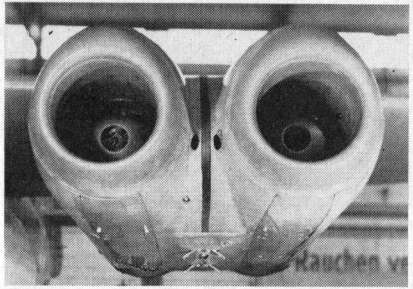
impossible. In fact, the problem of relighting the BMW 003 in flight was not finally solved until a few weeks before all development finally terminated, and in the meantime, production of the Ar 234C had been initiated at Alt Lönnewitz.

Apart from its power plants, the **Ar 234C** differed from the B-series in having a redesigned cockpit. Cabin pressurization had been applied to the Ar 234 V3 and several of the B-series prototypes, the glazed cockpit panels being sealed by synthetic rubber strips, washers of similar material being interposed between the flush-fitting retaining screws and the panels, but the Ar 234C featured a double-glazed cockpit, and the first C-series prototype to embody cabin pressurization was the **Ar 234 V20** which made its début late in October 1944, and during the previous month the similarly-powered Ar 234 V13 succeeded in attaining an altitude of 42,000 ft. By comparison with the Ar 234B, the Ar 234C embodied several detail modifications, such as a certain amount of skin re-contouring, some changes in aileron design, and an enlarged nosewheel, but apart from relighting the BMW 003 engines in flight, the principal problem was provided by the hermetic sealing of the control rods and leads.

Development of the C-series was considerably hampered by the fact that the experimental assembly plant had to be dispersed several times, and was complicated by the fact that several sub-variants were being evolved simultaneously. The initial model, the **Ar 234C-1**, was intended solely for reconnaissance



(Above) The Ar 234 *V*13 *was a B-series prototype fitted with four BMW* 003*A*–1 *turbojets, and (below) the port turbojet installation of the Ar* 234 *V*13

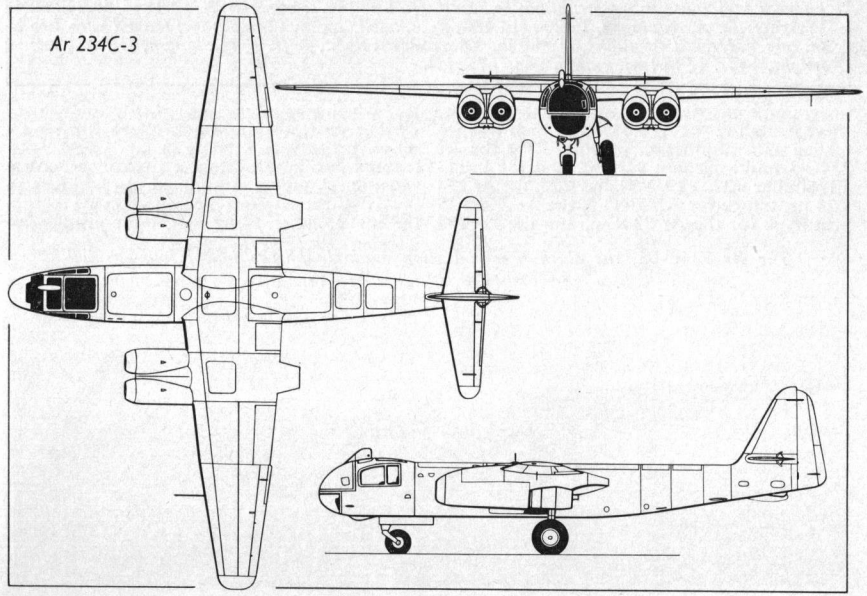


tasks with a similar camera array to the Ar 234B-1, but two aft-firing 20-mm. MG 151 cannon with 250 r.p.g. were to be housed in a ventral pack. The **Ar 234C-2** was an essentially similar machine intended for the bombing role and carrying no defensive armament. With a single 2,205-lb. bomb and two 1,100-lb. bombs, the Ar 234C-2 took-off within 972 yards, but this distance could be reduced to 667 yards with two 1,100 lb. thrust *Rauchgeräte* units. The **Ar 234C-3** was a multi-purpose model suitable for use as a bomber, night fighter or ground attack aircraft, and it was originally proposed that this version should receive the BMW 003C turbojets, which, with Brown-Boveri compressors, offered 1,980 lb.s.t. as compared with 1,760 lb. for the BMW 003A. The non-availability of this power plant, however, necessitated the retention of the BMW 003A. At an early stage, the pair of aft-firing MG 151 cannon was supplemented by a pair of similar weapons fixed to fire forward, also with 250 r.p.g.

A proposed BMW 003C-powered reconnaissance model was the **Ar 234C-4**, while the **Ar 234C-5** bomber was to have been the first two-seat variant, the pilot and navigator/bombardier being accommodated in staggered seats, and the **Ar 234C-6** was an equivalent long-range reconnaissance version. In view

of Germany's concentration on fighter production during the closing months of the war, it is hardly surprising that the Ar 234 should be considered for this role, and proposals were prepared for a specialised night fighting version of the C-series, the **Ar 234C-7**, which it was intended would be powered by a pair of Heinkel-Hirth HeS 011 turbojets of 2,860 lb.s.t., although the 2,200 lb. s.t Jumo OO4C was considered as an alternative. Armament was to have comprised one 20-mm. MG 151 cannon with 300 rounds in the forward fuselage and a ventral pack housing two 30-mm. MK 108 cannon with 100 r.p.g. Yet a further C-series proposal was the **Ar 234C-8** single-seat bomber with a fixed forward-firing armament of two 20-mm. MG 151 cannon with 250 r.p.g., a bomb load of 2,205 lb., and a pair of 2,310 lb.s.t. Jumo 004D turbojets.

Several C-series prototypes joined the test

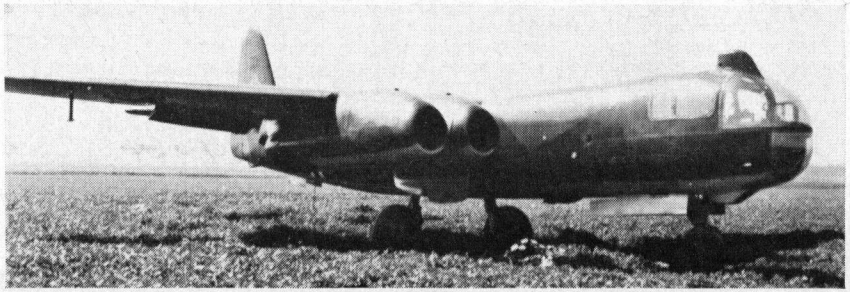


ARADO AR 234C BLITZ SPECIFICATION
(Specification relates to Ar 234C-1 with figures in parentheses applying to the Ar 234C-3)

Type: *Single-seat Reconnaissance (Bomber and Ground Attack) Aircraft.* **Power Plants:** *Four BMW 003A-1 Sturm axial-flow turbojets each rated at* 1,760 *lb.s.t.* **Armament:** *Two* 20-*mm. MG* 151 *cannon with* 250 *r.p.g. fixed to fire aft (and two* 20-*mm. MG* 151 *cannon with* 250 *r.p.g. fixed to fire forward and three* 1,100-*lb. SC* 500*J or SD* 500 *bombs, one* 2,205-*lb. SC* 1000 *or SD* 1000 *bomb and two* 550-*lb. SC* 250*J bombs, or three AB* 250 *or* 500 *anti-personnel bomb clusters).* **Performance:** *Maximun speed (without external load and half fuel),* 515 (496) *m.p.h. at sea level,* 542 (530) *m.p.h. at* 19,700 *ft.; range with maximum internal fuel,* 920 (765) *mls.; climb to* 32,810 *ft.,* 11.9 (16.7) *min.; service ceiling,* 39,370 *ft.* **Weights:** *Empty equipped,* 13,200 (14,400) *lb., loaded,* 20,600 (24,250) *lb.; loaded with two* 66 *Imp. gal. auxiliary tanks,* 21,800 *lb.* **Dimensions:** *Span,* 46 *ft.* 3½ *in.; length,* 41 *ft.* 5½ *in.; height,* 14 *ft.* 1¼ *in.; wing area,* 284.167 *sq. ft.*

programme before Germany's final collapse, these including the **Ar 234 V21** which was intended as a production prototype for the Ar 234C-3 multi-purpose variant, and the basically similar **V22**, **V23**, **V24** and **V25**, the **Ar 234 V28** prototype for Ar 234C-5, the **Ar 234 V29** prototype for the Ar 234C-6, and the **Ar 234 V27** which was intended primarily to evaluate various types of air brakes. Two further C-series prototypes, the **V26** and **V30** with laminar flow aerofoils, were virtually complete when development terminated. In addition to the 10 C-series prototypes completed before the final collapse, 14 Ar 234C-0 pre-production

The Ar 234*C-06, the sixth pre-production example of the initial four-engined derivative of the basic Ar* 234

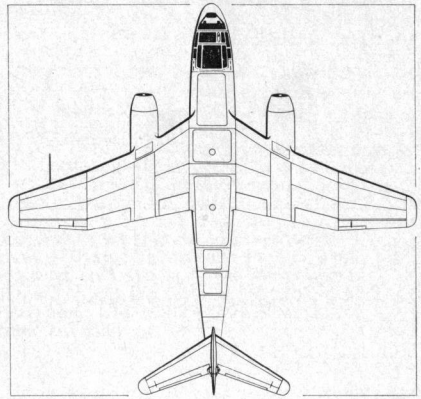


aircraft and Ar 234C-1 reconnaissance machines were rolled off the assembly line, but few received power plants and none was delivered to a service unit.

EXPERIMENTAL DEVELOPMENTS

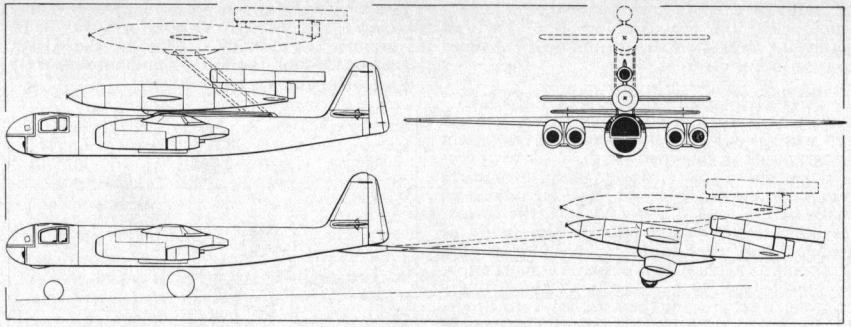
Throughout its development career, the Ar 234 was the subject of numerous development programmes concerned with various aerodynamic innovations, power plant, armament and other tests. Mention has already been made of the **Ar 234 V26** and **V30**, the former having a thick-section laminar flow wing of wooden construction and the latter a slim laminar flow section wing of metal construction, both prototypes being destroyed when virtually completed to prevent them falling into Soviet hands, but an even more interesting prototype intended for aerfooil research was the **Ar 234 V16**. The eighth B-series prototype airframe, the Ar 234 V16 was intended to test the revolutionary crescent wing planform evolved by Dipl. Ing. R.E. Kosin, Arado's chief aerodynamicist.

The design of the crescent wing was partly a compromise to maintain the existing Ar 234 undercarriage/fuselage c.g., utilizing the existing wing attachment points, but its primary purpose was that of maintaining a constant critical Mach number from root to tip by means of graded sweepback. The leading edge sweep angle was 37° inboard decreasing in two steps to 25° outboard, and the wing carried leading edge flaps. Power was to have been provided by a pair of BMW 003R units, these each comprising a normal BMW 003A turbojet coupled with a BMW 718 bi-fuel rocket motor which augmented thrust for take-off and climb by 2,700 lb. for three minutes. The experimental crescent wing was ready for attachment to the fuselage of the Ar 234 V16 in April 1945, but before this could be effected, the experimental assembly plant was occupied by British troops and the wing was scrapped. However, some two years later, this wing planform was to be resurrected by Handley Page in the U.K., tested in 1951 on the H.P.88 and subsequently adopted for the Victor bomber.



(*Above*) *The so-called 'crescent' wing planform of the Ar* 234 *V16. The airframe was scrapped after the Allied occupation of the experimental assembly plant*

The Ar 234 was also involved in *Deichselschlepp*, or "Air Trailer", trials which were initially aimed at providing the aircraft with an expendable long-range tank. Arado specified a 616 Imp. gal. towed tank for the Ar 234B and an 880 Imp. gal. tank for the Ar 234C, these being attached to the aircraft by means of a semi-rigid tube which acted as tow bar and fuel feed pipe. From the towed fuel tank



Two methods of launching the Fieseler Fi 103 *flying bomb were planned for the Ar* 234*C and are illustrated above. The first scheme entailed carrying the Fi* 103 *on a dorsal cradle which was to have been raised by a series of hydraulically actuated arms in order to clear the top of the parent aircraft. The second scheme entailed towing the Fi* 103 *by means of a non-flexible boom, the take-off trailer being jettisoned once the bomb was airborne*

was evolved various schemes for an offensive *Deichselschlepp*, and it was proposed that a 3,086-lb. bomb with rudimentary wing surfaces be towed behind the Ar 234C-2. Alternatively, a Fieseler Fi 103 flying bomb could be towed, the bomb being fitted with a two-wheel undercarriage and a tow bar attachment. It was proposed that the undercarriage be jettisoned after take-off and the tow bar detached when the bomb had been directed at its target. Extensive trials were undertaken at the *Erprobungstelle* Rechlin with an Ar 234B towing an Fi 103 from which the athodyd propulsion unit had been detached, but the definitive system involved the use of a cradle to which auxiliary wings and undercarriage were attached, the intention being that the cradle would be discarded after take-off, and glide to the ground for recovery and re-use.

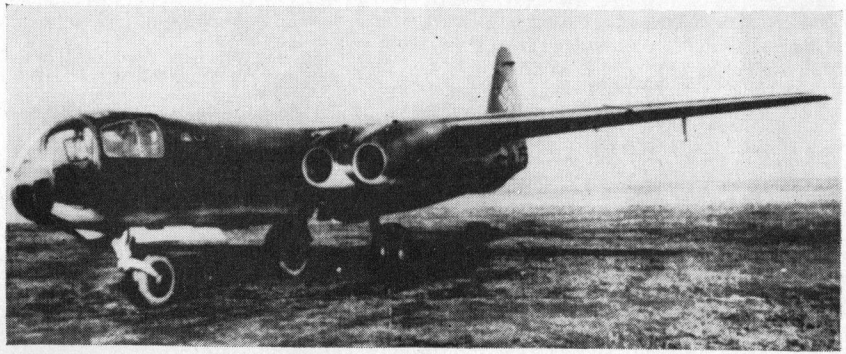
Yet a further *Deichselschlepp* scheme involved towing a Henschel Hs 294 missile behind an Ar 234C. With the Hs 294 on tow, the Ar 234C attained maximum speeds of 470 m.p.h. at sea level and 510 m.p.h. at 26,250 ft., range at the latter altitude being 475 miles and reducing to 250 miles at sea level. A rather more elaborate scheme was evolved for launching an Fi 103 from the back of an Ar 234C. This involved a special cradle on which the Fi 103 sat until the parent aircraft reached the vicinity of the target, a series of hydraulically-operated arms then raising the

missile clear of the top of the aircraft for launching.

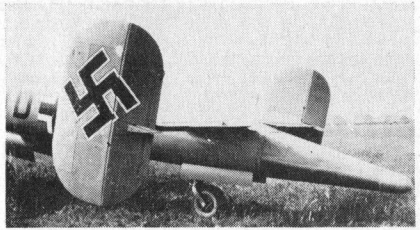
At the time the experimental assembly plant was occupied by the Allies, construction of a further batch of ten prototypes, the **Ar 234 V31** to **V40**, was in hand, these being intended for the D-series. A two-seater powered by a pair of 2,860 lb.s.t. Heinkel-Hirth HeS 011 turbojets, the Ar 234D was projected in two versions, the **Ar 234D-1** reconnaissance aircraft and the **Ar 234D-2** bomber. At an advanced design stage was the P-series intended for the night fighting role and featuring a lengthened fuselage nose accommodating centimetric intercept radar, increasing overall length to 43 ft. 6 in. Four versions were projected: **Ar 234P-1** powered by four BMW 003A turbojets and carrying two crew members and an armament of one 20-mm. MG 151 cannon with 300 rounds and one 30-mm. MK 108 cannon with 100 rounds; **Ar 234P-3** powered by two HeS 011 turbojets and carrying two crew members and a fixed forward-firing armament of two MG 151 cannon with 125 r.p.g. and two MK 108 cannon with 100 r.p.g.; **Ar 234P-4** differing from the -3 only in having Jumo 004D engines, and the three-seat **Ar 234P-5** with two HeS 011A turbojets, reduced fuel capacity (from 815 to 660 Imp. gal.), and an armament comprising one forward-firing MG 151 with 300 rounds and two MK 108s with 100 r.p.g., and an additional pair of MK 108s with 100 r.p.g. fixed to fire upward at an oblique angle.

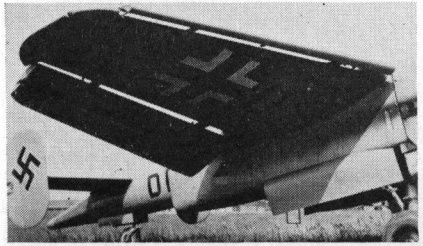
The Ar 234 was undoubtedly an extremely advanced warplane by any standard, and it was perhaps fortunate for the Allies that the numbers produced were sufficient to provide only an annoying thorn in their side.

The Ar 234 *V*21 *was intended as the production prototype for the Ar* 234*C*-3 *multi-purpose (bomber, night fighter and ground attack) model which was to have had BMW* 003*Cs*



During the late 'thirties, the technical director of the Arado Flugzeugbau, Dipl. Ing. Walter Blume, working in collaboration with the Rheinmetall-Borsig organisation, evolved what was for its time a revolutionary defensive system for aircraft comprising remotely-controlled low-drag gun barbettes directed by means of a periscopic sight. Although such barbettes were considered by many to be *too* futuristic, the *Technische Amt* of the *Reichs-luftfahrtministerium* (RLM) encouraged Blume to submit proposals for a fast *Kampfzerstörer* embodying his new concept for defence; an aircraft possessing advanced performance capability and suitable for use with equal facility in the heavy fighter, fast reconnaissance, dive-bombing and attack roles.

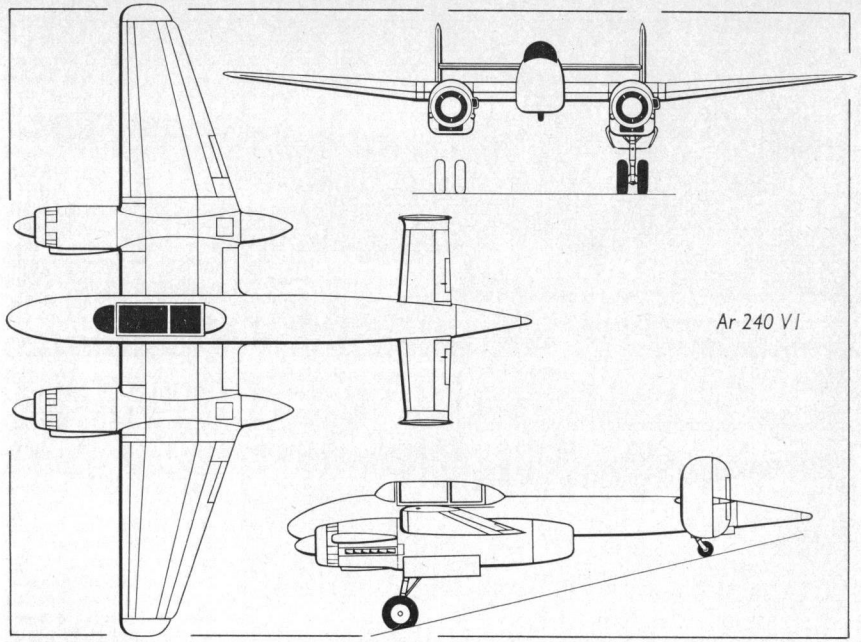




(*Above*) *The tail cone extension of the Ar* 240 *V*1, *and* (*below*) *the leading-edge slats and trailing-edge flaps/ailerons extended*

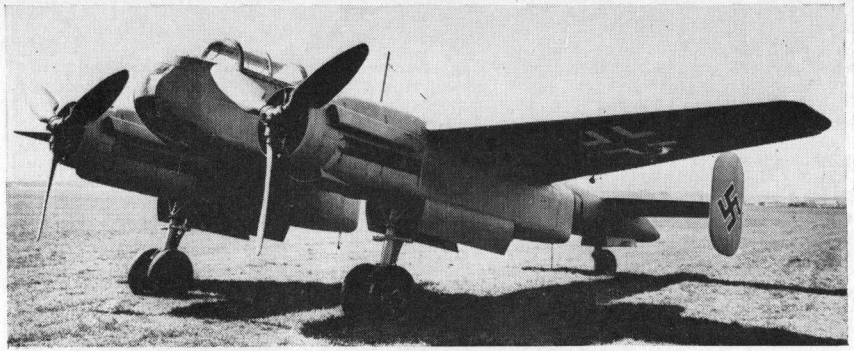
Thus, early in 1938, the Arado team initiated studies against an RLM development order for a highly sophisticated multi-purpose aircraft which was allocated to project designation E 240. The company's finalised proposal submitted to the RLM early in the following year took advantage of the very latest developments in aeronautical technology, and was basically a highly-loaded tandem two-seater of all metal construction with pressurized accommodation for the crew, remotely-controlled gun barbettes for defence, high-lift devices in the form of automatic leading-edge slats and double-slotted trailing-edge flaps, and a radical form of dive brake working in a similar fashion to a parachute and acting as a tail cone when closed.

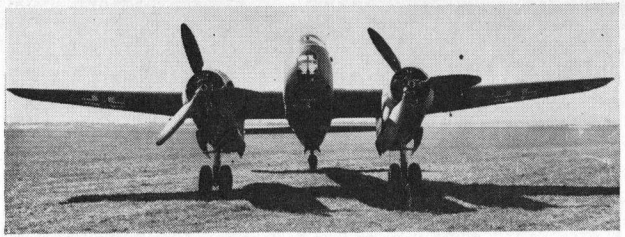
Dipl. Ing. van Nes was appointed overall project engineer for the E 240, *Oberingenieur* Hans Rebeski being structural supervisor. The *Technische Amt* drew up an official requirement which, in essence, merely outlined the salient features of the E 240, and during the summer of 1939, work began on prototype construction. The first two prototypes, the **Ar 240 V1** and **V2**, were intended to serve primarily as aerodynamic test vehicles, neither having provision for cabin pressurization and the FA 13 hydraulic control system for defensive barbettes, although the second aircraft featured forward-firing armament (comprising a fuselage-mounted pair of 20-mm. MG 151 cannon and a 7.9-mm. MG 17 machine gun in each



wing root). The FA 13 barbette control system, which, evolved by Arado in co-operation with the DVL as a successor to the totally unworkable LGW-developed FA 4 system, was at this time being flight tested on a Messerschmitt Bf 110C-1 and was proving to be fairly reliable during air firing trials, but development of the accompanying periscopic sight had fallen badly behind schedule.

One problem was target detection by the gunner and subsequent tracking despite 1.6 times magnification by the viewfinder, and an even more serious problem was presented by the icing-up of the periscopic heads when tested under simulated high-altitude conditions at Göttingen. After much experimentation,





(*Above and left*) *The Ar* 240 *V3 which, completed in the late spring of* 1941, *differed extensively from its predecessors*

the latter difficulty was finally solved by means of pumping pre-dried air into the sighting head through a chlorine-calcium filter, and it was ascertained that by this method it was possible to keep the sights free of ice up to an altitude of 32,150 ft.

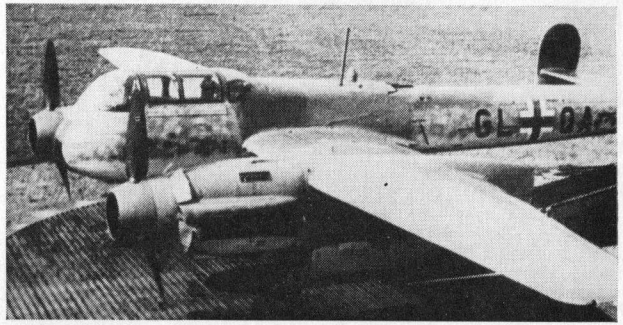
These tests were still under way when, on May 10, 1940, the Ar 240 V1 was flown for the first time, followed two months later in July by the Ar 240 V2, and from the outset of flight trials it was obvious that the new *Kampfzerstörer* was unstable about all *three* axes! Some redesign of the basic aircraft had already been undertaken, and the third prototype, the **Ar 240 V3** (KK-CD), then under construction as the first dive-bomber and reconnaissance model, featured radical changes in the forward and centre fuselage, the entire pressure cabin having been moved forward to the extreme nose. As a result of the unsatisfactory characteristics revealed by the first two prototypes, further changes were made in the Ar

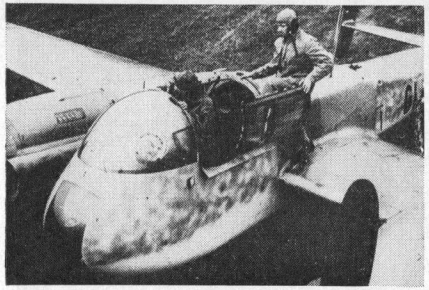
240 V3, the principal being the introduction of an additional 4 ft. 1½ in. section in the rear fuselage. The tail-mounted dive brake was removed and replaced by a short cone carrying auxiliary fins, and the wing leading-edge slats were eliminated. Like its predecessors, the Ar 240 V3 was powered by a pair of DB 601A engines each rated at 1,075 h.p. for take-off, and was the first aircraft to embody the FA 13 hydraulic barbette control system with dorsal and ventral barbettes each intended to house a pair of 7.9-mm. MG 81 machine guns. A similar fixed forward-firing armament to that of the Ar 240 V2 was installed.

These modifications delayed the completion of the Ar 240 V3 until the late spring of 1941 when flight tests revealed that, although markedly improved over those of the Ar 240 V1 and V2, flying characteristics still left much to be desired, and further modifications had to be made, including the provision of new ailerons. During the late summer months, the Ar 240 V3 was delivered to the *Aufklärungsgruppe* of the *Oberbefelshaber der Luftwaffe* for operational evaluation. The FA 13 system, which had proved reasonably reliable under test conditions but unsatisfactory in the field, was removed, together with the fixed forward-firing armament, a pair of RB 50/30 cameras was installed, and Colonel Knemeyer of the Aufkl.Gr.Ob.d.L. flew the aircraft as an unarmed reconnaissance machine, flying several sorties over Britain, its high-performance and high-altitude capabilities enabling the prototype to evade interception.

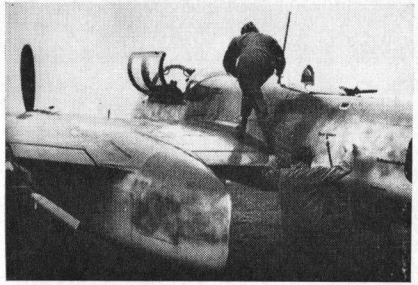
A fourth prototype, the **Ar 240 V4**, had, in the meantime, been completed by Arado, and the Ago Flugzeugwerke at Oschersleben had been designated subcontractor for the manufacture of a pre-production series of Ar 240A-0 aircraft for the reconnaissance role, having begun the necessary tooling. The Ar 240 V4

The Ar 240*A*-01 (*V*5), *on compass swinging platform* (*above and below*)





(*Above and below*) *The crew boarding the Ar 240A-01 (V5)*



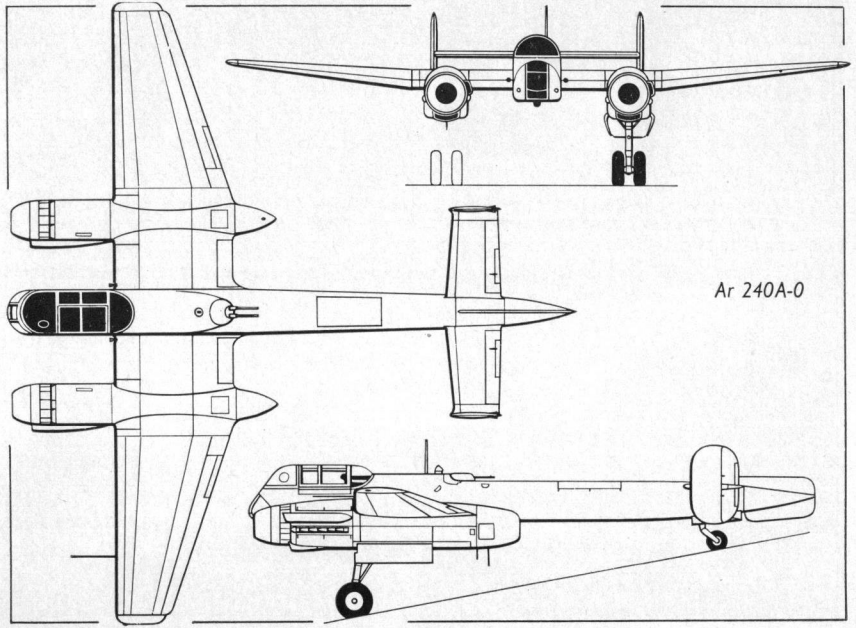
was primarily a dive-bomber with secondary reconnaissance capability, and forward-firing and defensive armament were similar to those initially installed in the V3, but racks were provided beneath the fuselage for eight 110-lb. bombs, the tail-mounted dive brake was reinstated, increasing overall length from 40 ft. 7⅛ in. to 42 ft. 8 in., and power was provided by two DB 603A engines each rated at 1,750 h.p. for take-off. Prior to the completion of dive-bombing trials, it had been concluded that the armed reconnaissance mission was of greater immediate importance than that of dive-bombing, priority being given to this role, and thus the first pre-production machines to be completed by Ago, the **Ar 240A-01** and-**02** (GL-QA and -QB) which also received the *Versuchs* numbers **V5** and **V6,** were intended solely for reconnaissance.

The Ar 240A-01 and -02, both flown in October 1942, embodied still more aerodynamic changes aimed at eradicating the poor handling characteristics that had continually plagued the development of the aircraft. Although unchanged in outline or dimensions, the wing was, in fact, entirely new. The revised wing section was of near-laminar type with the deepest point approaching mid-chord, and the characteristics of the aircraft were immeasurably improved as a result. The dive brake was finally dispensed with, and yet another Daimler-Benz engine variant was employed, the DB 601E rated at 1,175 h.p. for take-off. Forward-firing armament was restricted to the pair of wing root-mounted 7.9-mm. MG 17 machine guns, but the FA 13 system with its paired MG 81Z gun barbettes was retained. The two crew members were seated back-to-back in the pressurized forward section of the fuselage, the double-glazed canopy being sealed by inflatable rubber strips. Eight self-sealing fuel tanks housed 500 Imp. gal., and this could be augmented by a 132 Imp. gal. drop tank beneath the fuselage. An automatic RB 50/30 vertical camera was mounted in the tail of each engine nacelle. By this time, loaded weight had grown to 20,834 lb., and with a gross wing area of 336.91 sq. ft., wing loading was now no less than 61.5 lb./sq. ft.

A further three Ar 240A-0 reconnaissance aircraft were completed and flown by Ago in

October 1942, the first of these, the **Ar 240A-03,** flying initially with the DB 601E engines but subsequently being converted to take a pair of BMW 801TJ 14-cylinder air-cooled radials with turbo-superchargers and rated at 1,880 h.p. for take-off and 1,520 h.p. at 35,400 ft. The **Ar 240A-04** and **-05** (alias Ar 240A-0/U1 and U2 respectively), which were completed without defensive armament, were powered by DB 603A engines, and Ago had 80 per cent of the jigs and tools set up at Oschersleben in December 1942 for an initial production batch of 40 Ar 240As when a directive issued by Erhard Milch stopped the entire programme.

Despite the termination of the Ar 240 programme, the pre-production aircraft were promptly issued to service units. The Ar 240A-01 and -02 were delivered to *Jagdgeschwader* 5,



(Above) The Ar 240A-02 (V6) was operated briefly by JG 5 before transfer to 2.(F)/122, and (below) three Ar 240A-0s on the flight test line, the centre aircraft being the A-01 (V5)

the *Eismeergeschwader*, which, dispersed around Petsamo in the North of Finland, used the Arados for reconnaissance of the Murmansk Railway. During the summer of 1943, the Ar 240A-02 was transferred from JG 5 to 2.(F)/122 based at Frosinone, south-east of Rome. After a few test flights the aircraft performed its first operational reconnaissance mission but was completely written off on its return as the result of a bad landing. Shortly afterwards, the unit took over from 1.(F)/123 at Perugia, North of Rome, the Ar 240A-04 (A-0/U1), but before any operational missions could be flown with this aircraft, serious troubles developed with its DB 603A engines, and, after temporary repairs, it was flown back to Germany.

This aircraft, together with the Ar 240A-05 (A-0/U2), the BMW 801TJ-powered Ar 240A-03, and the Ar 240 V7 and V8, later served on the Southern Russian Front with *Aufklärungsgruppe* 10 and on the Eastern Russian Front with 1. *Staffel* of the Aufkl.Gr.Ob.d.L.

The **Ar 240 V7** and **V8**, which had been completed before Milch's edict and had flown in October and December 1942 respectively, were pre-production examples of the Ar 240B reconnaissance aircraft, and were also known as the **Ar 240B-01** and **-02** respectively. These were essentially similar to the Ar 240A-0 apart from having DB 605AM engines which, normally rated at 1,475 h.p. for take-off, had an MW 50 methanol-water injection system which could be used to boost take-off power to 1,800 h.p. Both the V7 and V8 were completed with the twin forward-firing MG 17 machine guns and the paired remotely-controlled MG 81Z barbettes, and the latter also had a fixed aft-firing 20-mm. MG 151 cannon.

Several other prototypes of the Ar 240 were completed, including the V9 (C-01), V11 (C-03) and V12 (C-04) heavy fighters, and the V10 (C-02) night fighter prototype, but although proposals existed for the Ar 240C-3 and Ar 240E bombers, the Ar 240C-4 fast reconnaissance aircraft, and the Ar 240D multi-purpose aircraft, the *Technische Amt* of the RLM refused to reinstate the Ar 240 programme, a decision undoubtedly motivated in part by the still imperfect flying characteristics of which pilots complained during operational trials, and the numerous small teething troubles which, when production was halted at the end of 1942, remained unresolved.

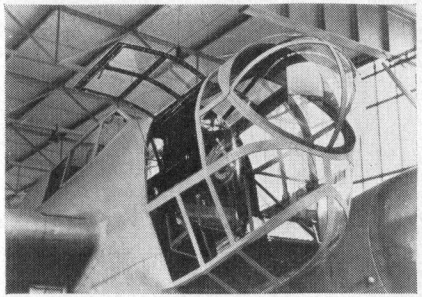
ARADO AR 240A-O SPECIFICATION

(Data in parentheses relates to the Ar 240B-0)

Type: *Two-seat Long-Range Reconnaissance Aircraft.* **Power Plants:** *Two Daimler-Benz DB 601E (DB 605AM) twelve-cylinder liquid-cooled engines each rated at* 1,175 (1,475) *h.p. for take-off.* **Armament:** (*Optional*) *Two fixed forward-firing* 7.9-*mm. MG* 17 *machine guns and two* 7.9-*mm. MG* 81 *machine guns in each of dorsal and ventral remotely-controlled barbettes* (*plus one fixed aft-firing* 20-*mm. MG* 151 *cannon on Ar* 240*B-O*2). **Performance:** *Maximum speed,* 384 (392) *m.p.h. at* 19,685 (19,685) *ft.; maximum cruising speed,* 345 (360) *m.p.h. at* 19,685 (19,685) *ft.; maximum range at* 345 (360) *m.p.h. at* 19,685 *ft. with* 132 *Imp. gal. auxiliary tank,* 1,242 (1,186) *mls.; time to* 19,685 *ft.,* 11 (10.6*: min.*) *service ceiling,* 34,450 *ft.* **Weights:** *Empty,* 13,669 *lb.; empty equipped,* 16,060 (15,322) *lb.; loaded,* 20,834 (19,621) *lb.; maximum overload,* 22,700 *lb.* **Dimensions:** *Span,* 43 *ft.* 9 *in.; length,* 42 *ft.* 0⅜ *in.; height,* 12 *ft.* 11½ *in.; wing area,* 336.91 *sq. ft.*

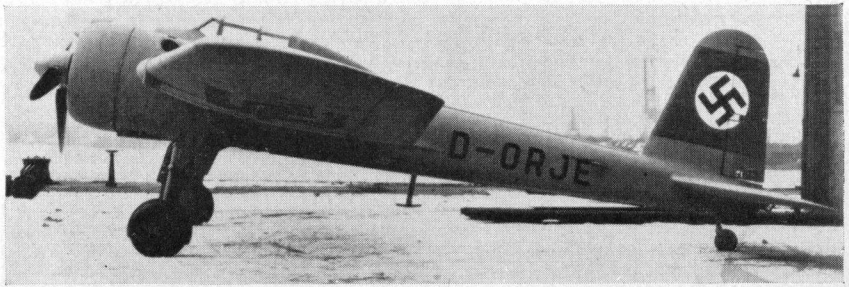
BLOHM UND VOSS BV 141 GERMANY

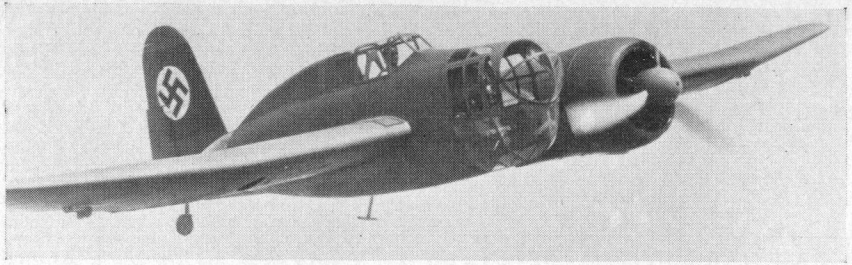
Every decade in the history of military aviation has seen its share of the unconventional in aircraft design; warplanes that, in concept or configuration, markedly deviated from what was considered to be orthodox at the time of their début. Few more unorthodox aircraft appeared in the 'thirties than Doctor Richard Vogt's asymmetrical BV 141 short-range reconnaissance and army co-operation machine which represented a highly novel approach to the problem of endowing a single-engined aircraft with outstanding all-round vision.



Early in 1937, the *Reichsluftfahrtministerium* (RLM) issued to several aircraft manufacturers a specification which called for a short-range reconnaissance aircraft capable of fulfilling the light bomber, low-level attack and smoke-screen laying roles in an emergency. The specification stipulated a single-engined three-seat machine, and emphasized the need for an outstanding all-round view for the crew members, and from an early stage the Arado company's proposal was favoured by the RLM's *Technische Amt*, this concern eventually being awarded a development contract for what was to be the totally unsuccessful Ar 198. The

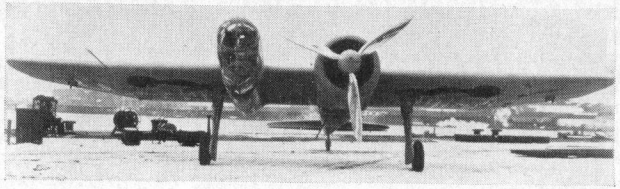
(*Above and below*) *The Ha* 141-0 (*later BV* 141 *V*2) *was originally built as a private venture and was initially flown on February* 25, 1938

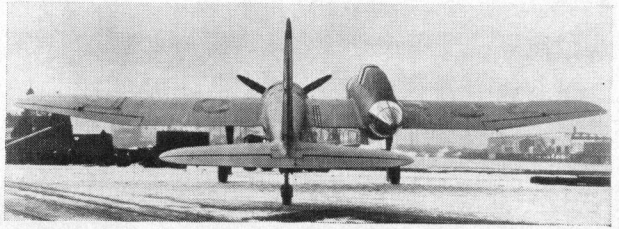




(*Above and below right*) *The distinctive fuselage nacelle unique to the Ha* 141*A*–0 (*later BV* 141 *V*2) *is clearly illustrated by these photos*

Hamburger Flugzeugbau, the aircraft division of the Blohm und Voss shipyards, had not been invited by the RLM to tender a proposal, but its newly-appointed technical director, Dr. Ing. Richard Vogt, had some revolutionary ideas concerning the best way to fulfil the RLM's specification, and accordingly submitted a private-venture proposal.

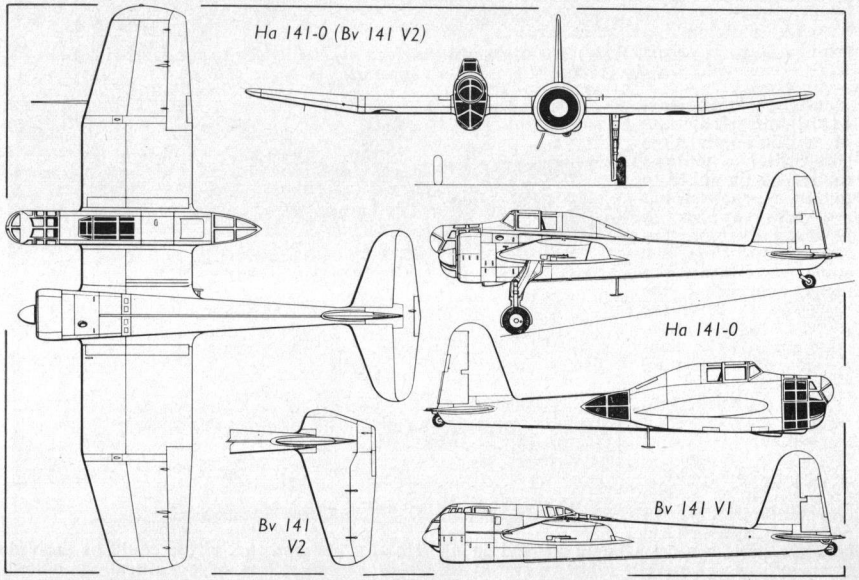


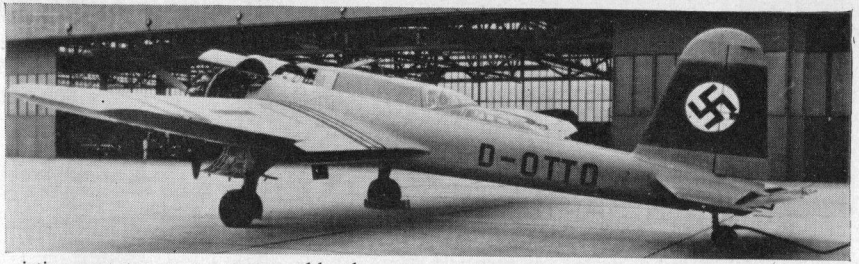


Vogt believed that the only way in which adequate all-round vision for reconnaissance purposes could be provided in a *single*-engined aircraft was to adopt an asymmetrical configuration, the crew being housed in an extensively-glazed nacelle offset to starboard. He also believed that virtue could be derived from necessity, the asymmetrically-mounted

crew nacelle cancelling out the airscrew torque which provided every designer of a single-engined aircraft with something of a headache. His proposal to the RLM was, therefore, for an asymmetric aircraft, but as Arado had already begun construction of the Ar 198, it was hardly surprising that little official interest was evinced in this unconventional design. However, Major General Ernst Udet, newly-appointed Director General of the *Technische Amt*, showed Vogt some encouragement and, the Hamburger Flugzeugbau having agreed to finance the project, work began on the strange prototype which, designated **Ha 141-0** and registered D-ORJE, flew for the first time on February 25, 1938.

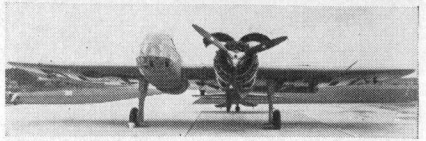
Apart from slight over-sensitivity of the control surfaces and minor undercarriage oscillation, the unorthodox Ha 141-0 proved singularly trouble-free, and after Udet himself had flight tested the prototype, an official contract was placed for three prototypes. The



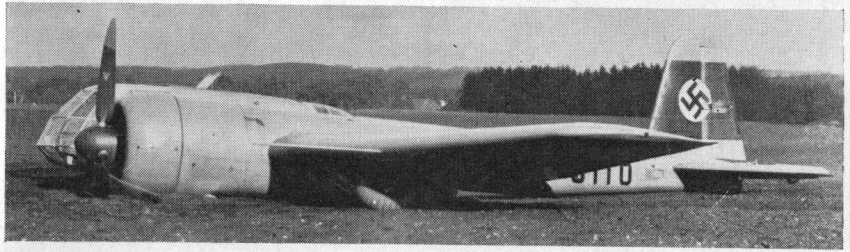


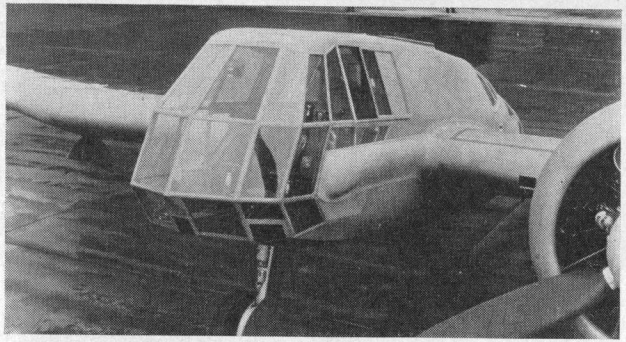
existing prototype was not covered by the contract, but after somewhat protracted negotiations, the RLM agreed to accept the machine as one of the three for which it had contracted, and D-ORJE was promptly allocated *Werk-Nr.* 172 and redesignated **BV 141 V2** (the name "Hamburger Flugzeugbau" having been abandoned), while the second prototype became the first *official* prototype as the **BV 141 V1** (*Werk-Nr.* 171).

The stepped cockpit of the BV 141 V2 (alias



(Above and right) The BV 141 *V*1 *(D-OTTO,) and (below) after forced landing in October* 1938





(Left and below left) The BV 141 V3 which was the first aircraft in the series to feature armament

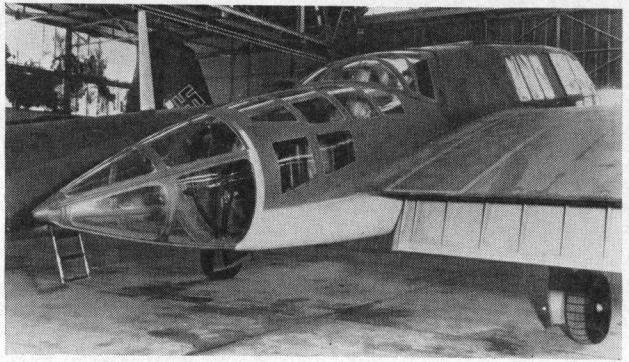
Ha 141-0) did not prove acceptable to the RLM and, in consequence, the entire crew nacelle was redesigned for the BV 141 V1, the new nacelle following closely the design of that of the Focke-Wulf Fw 189 which was under development simultaneously, and featuring copious glazing comprising a multitude of flat panels. Provision was made for two fixed forward-firing 7.9-mm. machine guns and two hand-held aft-firing guns of similar calibre (although the first aircraft actually to feature armament was the BV 141 V3), and underwing racks were provided for four 110-lb. bombs. The overall dimensions of the BV 141 V1 were slightly increased by comparison with the V2, span being extended from 49 ft. 2½ in. to 49 ft. 6½ in., resulting in a wing area of 449.93 as compared with 446.7 sq. ft., and length was raised from 36 ft. 5 in. to 37 ft. 4¾ in.

Registered D-OTTO, the BV 141 V1 weighed 6,812 lb. empty and 8,441 lb. in normal loaded condition, and was rolled out for initial flight trials in September 1938. Early in its test programme problems with the hydraulic system were encountered, and on October 5,

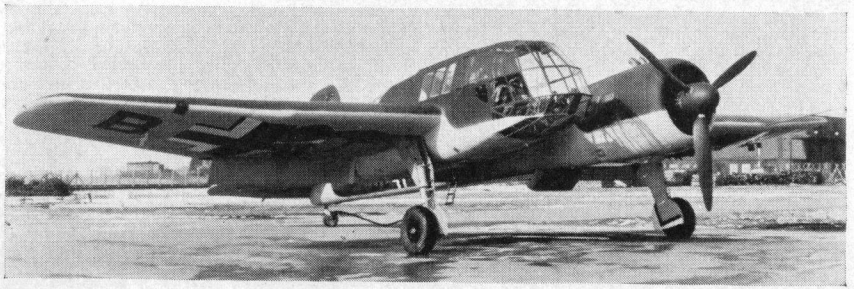
1938 a forced landing was made in a ploughed field with the mainwheel legs only half extended, the starboard wing suffering considerable damage. Fortunately, the **BV 141 V3** (D-OLGA) was available to participate in the flight test programme shortly after the V1 had come to grief, and this aircraft (*Werk-Nr.* 359) was considered to all intents and purposes a production prototype.

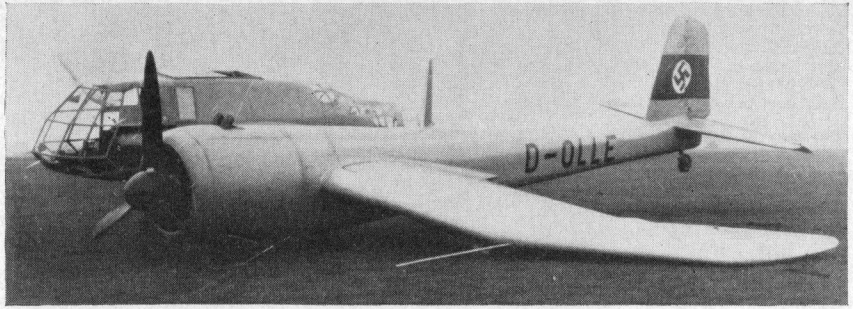
BLOHM UND VOSS BV 141A

In order to improve directional stability, the BV 141 V3's fuselage had been lengthened to 39 ft. 10⅛ in., and overall span was once more increased slightly to 50 ft. 4⅛ in., while to improve ground stability the wheel track was widened from 16 ft. 1 in. to 16 ft. 10¾ in. The crew nacelle accommodated the pilot to port with the observer to starboard, and the observer's seat was attached to a track so that when pushed to its forward extremity it en-



(Right and below) The BV 141 V3 was considered by Blohm und Voss as a production prototype and embodied operational equipment





The first pre-series BV 141A–0 (V4), D-OLLE, seen after a mainwheel leg failed to lock in the down position during a landing

abled him to operate the bomb sight, the radio equipment being situated at the aft end of the seat track. The observer also operated the camera and, in an emergency, the upper aft-firing machine gun. The entire nacelle was of minimum section, measuring only 3 ft. 11¼ in. from side to side, and 4 ft. 11 in. from top to bottom, and terminated in a pointed cone housing a similar 7.9-mm. MG 15 machine gun to that mounted in the upper position. Of Focke-Wulf design, this rear position could be rotated through 360 deg., the gunner being prone over the wing trailing edge.

The tailplane was almost symmetrical, and trim tabs were fitted in the elevators, rudder and port aileron, and the ailerons were balanced by means of two spoilers on each outer wing section, these being interconnected with the ailerons. All control surfaces were actuated by rods, the flaps and undercarriage being hydraulically operated. Power was provided by a nine-cylinder BMW 132N radial air-cooled engine offering maximum power of 865 h.p. for one minute at sea level and 960 h.p. at 9, 842 ft., and this was fed from a 108 Imp. gal. fuel tank immediately aft of the engine firewall. Apart from the two fixed-forward-firing MG 17s and two aft-firing MG 15s on flexible mountings, the BV 141 V3 had four ETC 50 bomb racks and an automatic camera (RB 20/30, 21/18, 50/18 or 50/30).

Even the RLM, which had viewed the BV 141 with the utmost suspicion from the outset, was forced to admit that, despite its highly unorthodox appearance, the aircraft possessed extremely docile handling characteristics and fully met the original specification. Somewhat reluctantly, an order was placed for a pre-series of five aircraft (BV 141A-01 to 05), but these machines were also allocated *Versuchs* numbers, and thus the **BV 141A-01**, which was registered D-OLLE, was also known as the **BV 141 V4**. This aircraft (*Werk-Nr.* 360) joined the test programme early in 1939. Wing span and area were slightly increased, from 50 ft. 4⅛ in. to 50 ft. 8¼ in. and from

457.466 sq. ft. to 461.233 sq. ft., but empty weight was actually reduced from 7,064 to 6,845 lb., normal loaded weight remaining constant at 8,598 lb. The "Achilles heel" of the BV 141 remained its hydraulic system, however, and shortly after commencing flight testing the BV 141 V4 suffered an accident when one mainwheel leg locked down and the other remained up during a landing. As this aircraft was intended for trials at the *Erprobungstelle* Rechlin there was an inevitable delay in the initiation of the official evaluation programme.

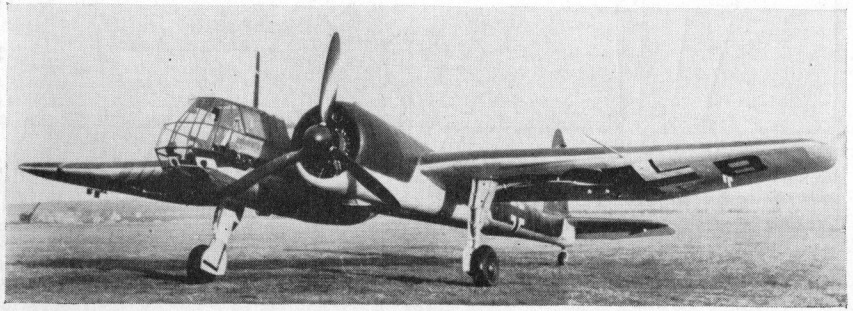
The remaining four BV 141A-0 pre-series aircraft, the **V5** (*Werk-Nr.* 361), the **V6** (*Werk-Nr.* 362), the **V7** (*Werk-Nr.* 363), and the **V8** (*Werk-Nr.* 364), were completed to schedule and were virtually identical to the V4, the only change of any importance being the provision of a new upper defensive position which replaced the sliding hatch.

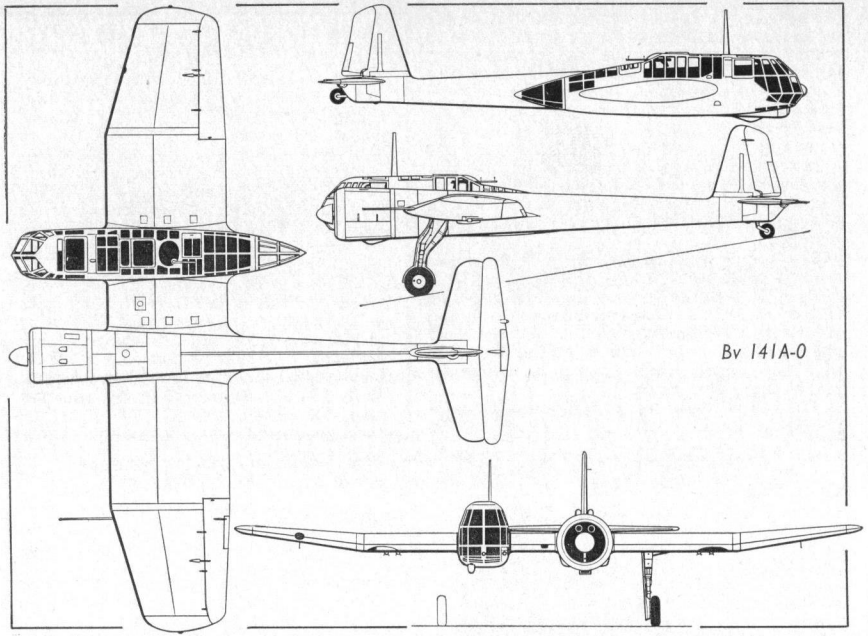
The official flight test programme was completed at Rechlin with the BV 141 V5 in

BLOHM UND VOSS BV 141A-04 (V7) SPECIFICATION

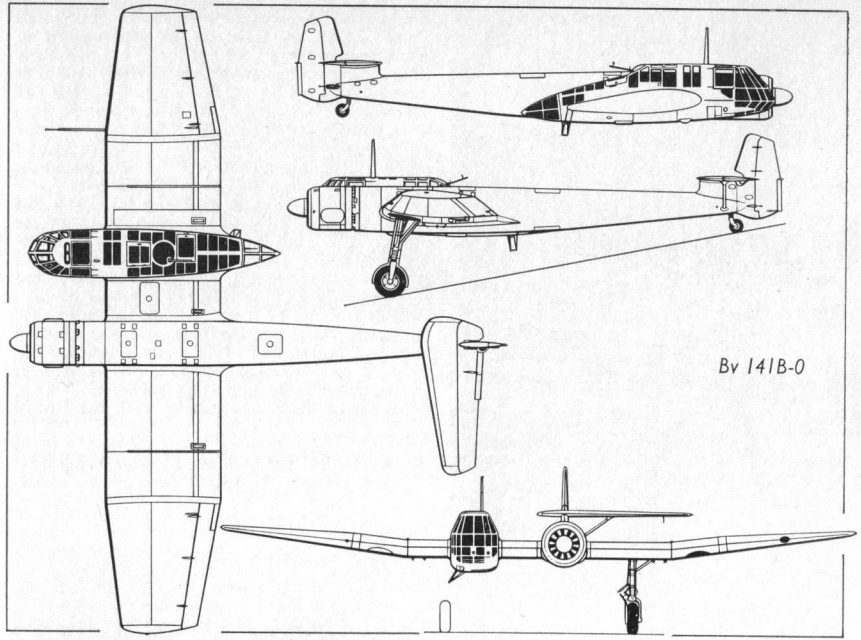
Type: *Three-seat Tactical Reconnaissance and Army Co-operation Aircraft.* **Power Plant:** *One BMW 132N nine-cylinder radial air-cooled engine rated at 865 h.p. at sea level and 960 h.p. at 9,840 ft.* **Armament:** *Two fixed forward-firing 7.9-mm. MG 17 machine guns and two aft-firing 7.9-mm. MG 15 machine guns on flexible mountings. (Offensive) Four 110-lb. bombs on underwing racks.* **Performance:** *Maximum speed, 211 m.p.h. at sea level, 248 m.p.h at 12,467 ft.; maximum cruising speed, 193 m.p.h. at sea level, 227 m.p.h. at 14,765 ft.; maximum range, 708 mls.; service ceiling, 29,530 ft.* **Weights:** *Empty equipped, 6,982 lb.; loaded, 8,598 lb.* **Dimensions:** *Span, 50 ft. 8¼ in.; length, 39 ft. 10⅛ in.; height, 13 ft. 5½ in.; wing area, 461.233 sq. ft.*

The second pre-series BV 141A–0 (V5) with which the official flight test programme was completed at Rechlin. This aircraft was later used for bombing trials



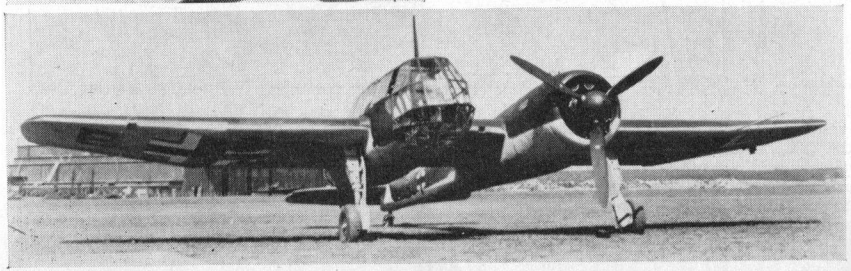


January 1940, and the *E-Stelle* pilots' reports were generally favourable. For low-level bombing a special bomb sight had been developed and installed in the V5, and 13 bombing trials were undertaken, a total of 58 bombs being dropped from various altitudes. The BV 141 V3 also participated in bombing trials at Rechlin and Tarnewitz. The *Luftwaffe*'s High Command, the OKL, displayed little enthusiasm for this "oddity", and on April 4, 1940 succeeded in persuading the RLM to cancel its plans for large-scale production of the BV 141A as it was considered that this offered no advantages over the Focke-Wulf Fw 189.



BLOHM UND VOSS BV 141B

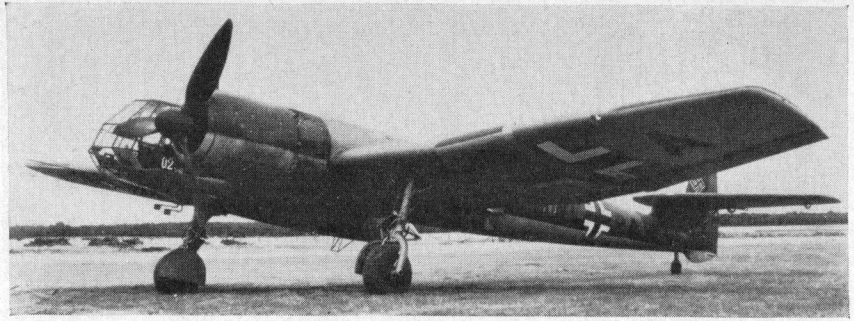
The OKL's lack of enthusiasm for the BV 141 resulted primarily from the unorthodox appearance of the aircraft, and in casting around for a valid technical reason for the rejection of the Blohm und Voss machine, it decided to base its decision on the fact that the BV 141A-0 was marginally underpowered. Dr. Vogt had already forseen the possibility that more power would be demanded, and as early as January 1939, his team had begun the redesign of the basic aircraft to take the substantially more powerful BMW 801. A complete structural redesign was undertaken, and



(Left) A BV 141A-series aircraft being refuelled during Luftwaffe evaluation, and (below) the BV 141 V8, the last of the A-series airframes to be built

the final mock-up of what was to be designated the BV 141B was inspected and approved by an RLM commission on February 14, 1940. Less than a year later, on January 9, 1941, the first of five pre-series **BV 141B-0** aircraft, the **BV 141 V9** (NC-OZ), flew for the first time. At this time, Blohm und Voss held a firm contract for only five BV 141B-0 aircraft, but the RLM had taken options on a further five pre-production machines and 10 production BV 141B-1s.

It was soon obvious that the BV 141B did not share the pleasant characteristics of its predecessor. Static vibration trials in November 1940 had revealed the fact that substantial strengthening of certain components was called for, and it had been found that major modifications had to be made to the tail assembly supports, the undercarriage and the control system. Static tests had been continuously plagued by hydraulic troubles, problems with the undercarriage actuating mechanism and, when engine runs had begun, with the BMW



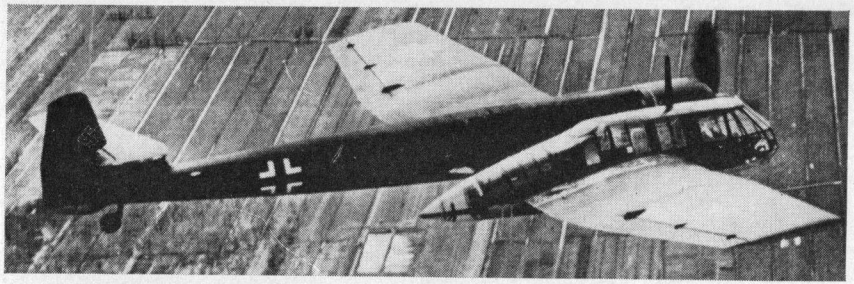
The BV 141B-02 (V10) was not flown until June 1, 1941 owing to the non-availability of a suitable airscrew

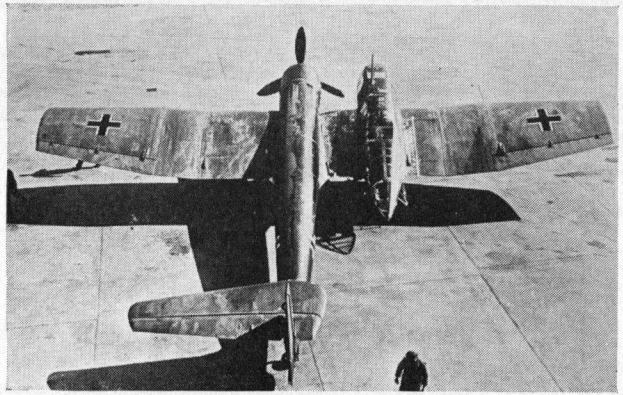
801 power plant itself. By the time that flight trials began, the results of vibration tests had still to be fully evaluated and, in consequence, the BV 141 V9 had to be limited to a maximum speed of 280 m.p.h. Aileron trimming proved ineffective, the ailerons themselves proved oversensitive, functional defects in the hydraulic system, and numerous other troubles disrupted the entire test schedule.

Completion of the remaining four BV 141B-0 aircraft was slowed pending the satisfactory outcome of modifications to the BV 141 V9. By comparison with the BV 141A, B-series aircraft featured enlarged dimensions, equitapered outboard wing panels were introduced, the oval section of the fuselage gave place to a circular section over its entire length, and the tail surfaces were entirely redesigned. Earlier, the BV 141 V2 had tested a further innovation—an asymmetric tailplane. In order to improve the rear gunner's field of fire, the starboard half of the tailplane had been

BLOHM UND VOSS BV 141B-02 (V10) SPECIFICATION

Type: *Three-seat Tactical Reconnaissance and Army Co-operation Aircraft.* **Power Plant:** *One BMW 801A-0 14-cylinder radial air-cooled engine rated at* 1,560 *h.p. for take-off.* **Armament:** (*Defensive*) *Two fixed forward firing* 7.9-*mm. MG* 17 *machine guns and two aft-firing* 7.9-*mm. MG* 15 *machine guns on flexible mountings.* (*Offensive*) *Four* 110-*lb. SC* 50 *bombs on underwing racks.* **Performance:** *Maximum speed,* 229 *m.p.h. at sea level,* 272 *m.p.h. at* 16,400 *ft.; normal range,* 745 *mls.; maximum range,* 1,180 *mls.; service ceiling,* 32,810 *ft.* **Weights:** *Empty equipped,* 10,362 *lb.; normal loaded,* 12,566 *lb.; maximum,* 13,448 *lb.* **Dimensions:** *Span,* 57 *ft.* 3½ *in.; length,* 45 *ft.* 9¼ *in.; height,* 11 *ft.* 9¾ *in.; wing area,* 569.41 *sq. ft.*





(Above and left) A BV 141B-0 during service evaluation in 1941

removed and the port half increased in size, and as this modification resulted in no noticeable deterioration in handling qualities, the asymmetric tailplane was adopted for the BV 141B.

The BV 141 V9 was eventually delivered to the *E-Stelle* at Rechlin in May 1941, and it was joined there by the **V10** (NC-RA) which had finally flown on June 1, 1941 after having gathered dust for some three months in the Blohm und Voss plant while the delivery of an airscrew was awaited. Constant minor failures troubled the official evaluation programme, and when the fourth BV 141B, the **V12** (NC-RF), was delivered to Tarnewitz for armament trials, it was discovered that the gun ports were too short, and that cordite fumes filled

the cockpit when the guns were fired. In the meantime, the **BV 141 V11** (NC-RC) had joined the test programme, but teething trouble followed teething trouble, and it was hardly surprising, therefore, that the fifth and last BV 141B, the **V13** (NC-RH), was not delivered until May 15, 1943.

In the autumn of 1941, the second BV 141B, the V10, had been delivered to *Aufklärungschule* 1 at Grossenhain, Saxony, for trials under service conditions, and shortly afterwards, the *General-Luftzeugmeister* issued instructions that sufficient BV 141Bs should be delivered to form at least one operational squadron on the Eastern Front.

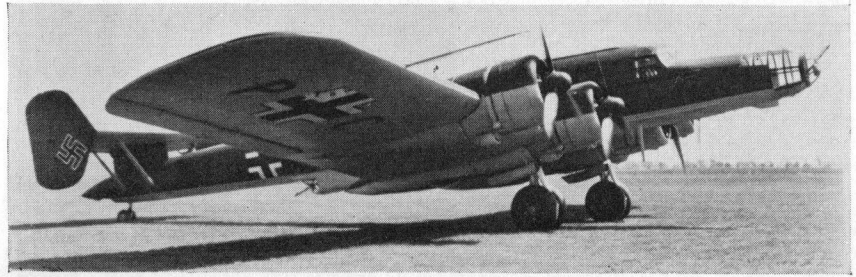
Plans for the *Sonderstaffel BV* 141 were finally cancelled by the General Staff in the spring of 1942, as, by that time, the role for which the BV 141B had been forseen was being adequately fulfilled bythe reliable Focke-Wulf Fw 189. This decision was undoubtedly also influenced by the teething troubles being suffered by the BV 141, and a third motivation was probably the desire to ensure deliveries of the Focke-Wulf Fw 200 Condor, some 80 per cent of available Blohm und Voss assembly shop space having been taken over for the Fw 200 after damage to the Focke-Wulf plant in a bombing raid. Thus, the RLM's option on a further five pre-production machines and 10 production examples was never taken up, and the peculiar BV 141 was destined never to see operational service.

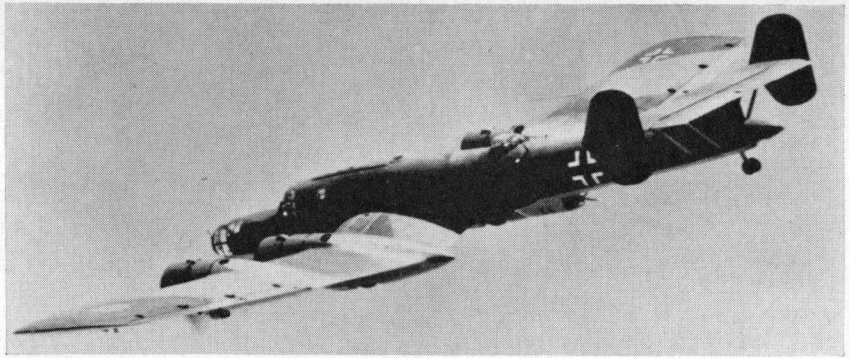
BLOHM UND VOSS BV 142 — GERMANY

The success that attended the initial flight trials of the Ha 139 long-range float seaplane in 1937 prompted the Hamburger Flugzeugbau, the aircraft division of the Blohm und Voss shipyards, to evolve a land-based version of the basic design using as many components of the floatplane as was feasible.

Intended for the role of long-range mailplane capable of operating over distances up to 2,735 miles, the landplane, designated Ha 142,

The BV 142 *V2/U1 maritime reconnaissance aircraft was an adaptation of the second BV* 142 *(D-ABOV) transatlantic mail-carrier*

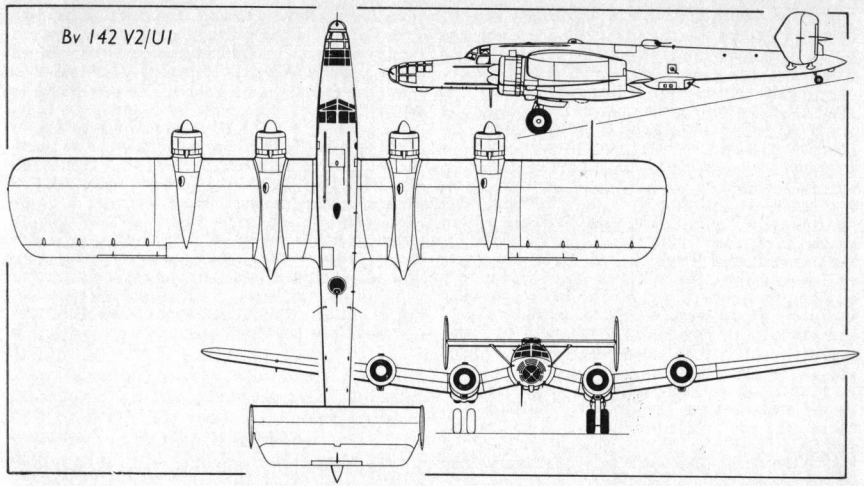


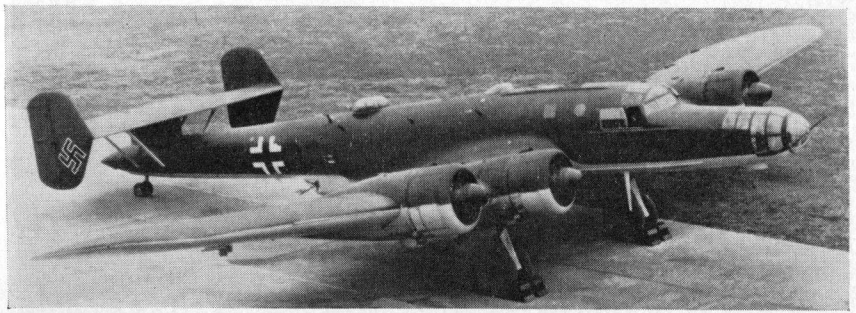


(Above and at foot of opposite page) The BV 142 V2/U1 was delivered during the autumn of 1940 to 2./Aufkl.St.Ob.d.L.

was of all-metal construction, and employed a similar circular-section monocoque fuselage and inverted gull wing to those of the Ha 139 The fuselage was built up of cross-frames and longitudinal stringers with flush-riveted light alloy skinning, the main bulkheads being heavy box frames. The parallel-chord wing, which was of the extended-span type applied to the Ha 139 V3, was built up on a large-diameter tubular load-carrying spar which, tapered in thickness to meet the required loads, was sealed to form a fuel tank with a maximum capacity of 1,399 Imp. gal. The centre section, which featured marked anhedral between the fuselage and inboard engine nacelles, had flush-riveted metal skinning and carried the four sections of the hydraulically-operated flaps, and the outboard wing panels were fabric covered. The crew comprised pilot, co-pilot, navigator and radio-operator, and the flight deck was separated from the small mail compartment by the centre-section spar. The twin floats of the Ha 139 were replaced by hydraulically-operated rearward-retracting twin-wheel main undercarriage members and a retractable twin-wheel tail member.

The first prototype, the **Ha 142 V1** registered D-AHFB, was flown on October 11, 1938, followed within a few weeks by a second prototype, the **BV 142 V2** registered D-ABOV, by this time the name "Hamburger Flugzeugbau" having been abandoned. Two further prototypes joined the test programme in the spring and summer of 1939, it being intended that all four aircraft would be operated on trans-atlantic mail-carrying flights by Deutsche Lufthansa (DLH). However, after a few exploratory flights, DLH returned the BV 142s to Blohm und Voss, plans for the commercial operation of the aircraft being abandoned.





Shortly after the beginning of World War II, the idea of adapting the BV 142 for the long-range maritime and strategic reconnaissance tasks was conceived, and the first two prototypes were selected for trial adaption. As the BV 142 was intended to operate far outside the range of fighter protection in its new role, emphasis was placed on defensive armament. The fuselage nose was elongated, terminating in an extensively-glazed compartment for the bombardier and a mounting for a single 7.9-mm. MG 15 machine gun. An electrically-operated dorsal turret, also mounting a single MG 15, was introduced aft of the wing trailing edge, and a ventral cupola of an He 111H-6 was fitted, this providing a housing for a similar weapon. Ports were provided in the waist of the aircraft for two beam-firing MG 15 guns, and the mail compartment immediately aft of the main spar was adapted as a bomb-bay, this dictating the provision of a number of external stiffeners on the forward fuselage. As there was no provision for access to the aft fuselage from the flight deck, a trap in the upper fuselage decking provided entry and egress for the dorsal and ventral gunners. The crew complement was increased to six, the navigator doubling in the role of bombardier, and the remainder of the crew comprising pilot, co-pilot, radio-operator and two gunners. The rudimentary bomb-bay provided accommodation for an extremely modest load comprising eight 110-lb. or four 220-lb. bombs, and extensive radio and navigational equipment, the so-called *Transozean-Funkanlage*, was installed.

Designated **BV 142 V2/U1** (PC-BC), the first conversion was completed in the spring of 1940 and delivered during the following autumn to 2./Aufkl.St.Ob.d.L., being attached directly to the Headquarters of *Luftflotte* 3. The first prototype was allegedly converted in a similar fashion as the **BV 142 V1/U1** (PC-BB), and plans existed to convert the remaining two prototypes. In the meantime, however, limited transport capacity had necessitated the use of these aircraft in the invasion of Denmark and Norway, the **BV 142 V3** and **V4** operating in concert with a miscellany of other types (e.g., Ju 89, Ju 90, Fw 200B) under *Fliegerkorps X*, and their ultimate fate is uncertain. The number of sorties operated by the two converted BV 142s was strictly limited by their vulnerability, performance when carrying full warload being appreciably below that originally anticipated, and by 1942 they had been withdrawn from service. A scheme existed to employ these aircraft as launching platforms for the Blohm und Voss GT 1200C guided torpedo, but there is no evidence to indicate that this proposal saw fruition.

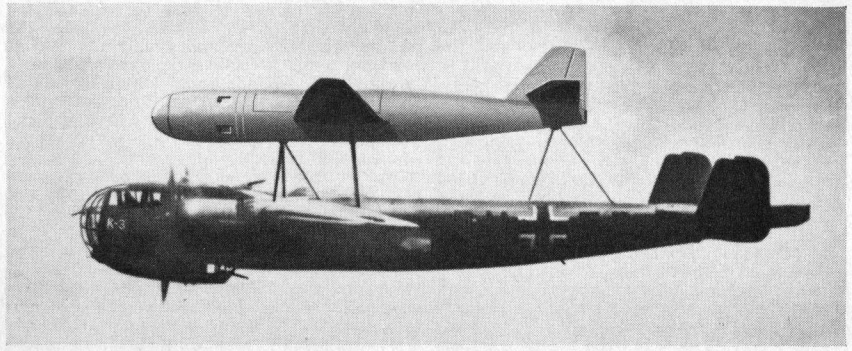
BLOHM UND VOSS BV 142 V2/U1 SPECIFICATION

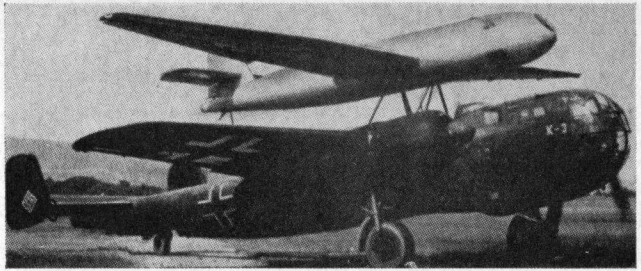
Type: *Six-seat Maritime and Strategic Reconnaissance Aircraft.* **Power Plants:** *Four BMW* 132*H*-1 *nine-cylinder radial air-cooled engines each rated at* 880 *h.p. for take-off.* **Armament:** *One* 7.9-*mm. MG* 15 *machine gun in each of nose, ventral and two beam positions, and one* 7.9-*mm. MG* 15 *machine gun in electrically-operated dorsal turret.* (*Offensive*) *Four* 220-*lb. ar eight* 110 *lb. bombs internally.* **Performance:** *Maximum speed,* 232 *m.p.h. at sea-level; maximum cruising speed,* 202 *m.p.h. at* 6,560 *ft.; maximum range* (*without bomb load*), 2,420 *mls.; service ceiling,* 29,530 *ft.* **Weights:** *Empty equipped,* 24,427 *lb.; maximum loaded,* 36,508 *lb.* **Dimensions:** *Span,* 96 *ft.* 10¾ *in.; length,* 67 *ft.* 2⅛ *in.; height,* 14 *ft.* 6⅜ *in.; wing area,* 1,399.3 *sq. ft.*

From the beginning of World War II, the German General Staff attached great importance to reconnaissance aircraft, and considerable ingenuity was displayed by the German aircraft industry in evolving aircraft for the reconnaissance role capable of operating at altitudes endowing them with a measure of immunity from interception. The most revolutionary of these aircraft was undoubtedly the DFS 228 which, developed by the Deutsches Forschungsinstitut für Segelflug, was in effect a rocket-propelled sailplane. The idea of developing an aircraft that could be propelled to extreme altitudes by means of a rocket motor and subsequently soar for considerable distances was conceived in 1940, and in the following year, an outline specification was issued to the DFS by the *Technische Amt* of the RLM. Although design work was initiated immediately, more pressing commitments necessitated shelving the project until, in 1943, it was revived by orders from the RLM.

Designated DFS 228, the aircraft was intended to be carried or towed to an altitude of 33,000 ft. at which it would be released or cast off from the parent aircraft or tug, the rocket then being lighted and the service ceiling of 75,000 ft. being attained. From this altitude the rocket motor was to be used intermittently for a series of steep climbs interspersed between shallow glides, maximum ceiling being maintained for 45 min. At the end of this time the rocket fuels were expected to be exhausted and a long glide commenced during which

The DFS 228 *V*1 *reconnaissance aircraft is seen below on the Do* 217*K V*3 *which carried this remarkable aircraft to altitude for gliding trials*





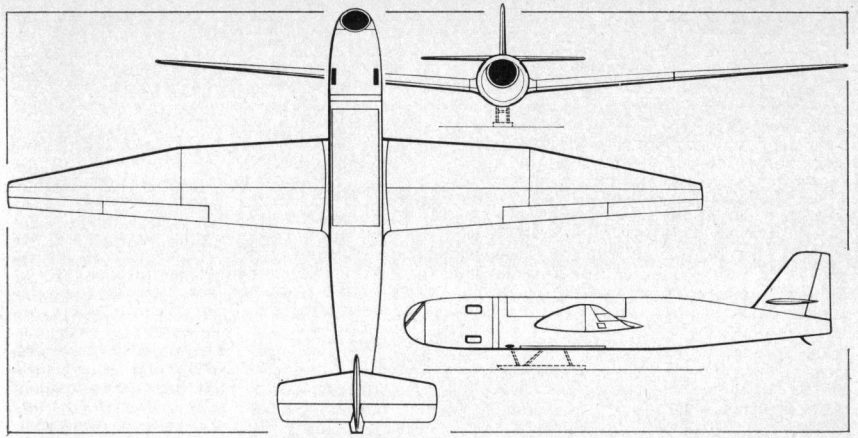
The DFS 228 V1 was flown extensively from the back of the Do 217K V3 but no powered flight was attempted

reconnaissance photographs were to be taken with infra-red cameras. By the time an altitude of 39,400 ft. was reached it was estimated that the aircraft would have travelled a total distance of 465 miles. A further 185 miles could be covered during the glide from 39,400 ft., although this distance could be increased by making use of thermals in the fashion of a high-performance sailplane, the aircraft landing on a retractable skid.

Wood was employed wherever possible in the construction of the DFS 228, and the simple semi-monocoque fuselage was built in three sections; the pressurized nose compartment, the fuselage centre section and the tail cone. The wing employed a single laminated wooden spar extending from tip to tip, with wooden ribs and plywood skinning. The fabric-covered ailerons extended over half the span and operated in two sections, the inner sections serving as flaps during landing. Lift spoilers were fitted to both upper and lower wing surfaces. The pressurized nose compartment was a metal two-skin structure sealed by a rear bulkhead and three plexiglas panels, and maintained a pressure equivalent to an altitude of 26,000 ft. Provision was made for the circulation of hot air between the plexiglas panels and temperature and humidity were maintained at a constant level by means of an electrically-driven air-conditioning unit. No mechanical load was imposed on the nose compartment shell, the inner skin withstanding air pressure loads inside the cabin and the outer skin contending with external pressures, insulation being provided by aluminium foil between the skins, and the pilot, who, supported in a prone position by a couch arrangement attached to the rear bulkhead, breathed pure oxygen. The entire nose compartment was jettisonable and was attached to the main fuselage by means of four explosive bolts, being stabilized after jettisoning by means of an automatically-deployed parachute. After reaching a predetermined height it was proposed that the pilot's couch would be ejected from the compartment by compressed air, his oxygen and R/T leads and safety harness being disconnected simultaneously with his parachute opening.

The wooden fuselage centre section also had two skins, and housed two Zeiss infra-red cameras, and the C-Stoff and T-Stoff tanks, together with the Walter HWK 109-509 bi-fuel liquid rocket motor. A retractable metal landing skid was housed in the lower part of the centre fuselage, and the tail cone merely carried the rocket combustion chamber and tailskid.

The **DFS 228 V1** was completed in 1943, and



extensive trials were carried out by the DFS and at the *Erprobungstelle* Rechlin, the Do 217K V3 being employed as a carrier aircraft. A second prototype, the **DFS 228 V2**, was completed, and handling trials without the rocket motor installed were generally satisfactory, although test pilots found the aircraft to be unusually sensitive to elevator movements and reported that aileron effectiveness was poor at altitude. Although powered flight had not been attempted at the time of Germany's collapse, the construction of a pre-production batch of 10 **DFS 228A-0** aircraft had begun at Griesheim, near Darmstadt, and the DFS was working on the design of a more advanced successor, the supersonic DFS 346 which was expected to attain a speed of 1,250 m.p.h. (Mach 1.9) at 66,000 ft.

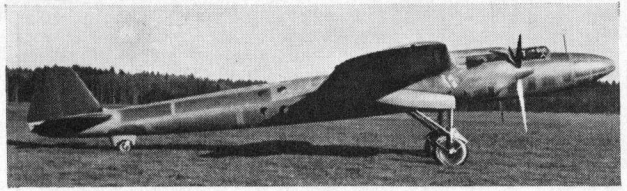
DFS 228 SPECIFICATION

Type: *Single-seat High-altitude Reconnaissance Aircraft.* **Power Plant:** *One Walter HWK* 109-509 *bi-fuel liquid rocket motor rated at* 3,300 *lb.s.t. at sea level and* 3,630 *lb. at* 40,000 *ft.* **Performance:** *Maximum speed,* 565 *m.p.h. at sea level; maximum range,* 650 *mls.* (*comprising* 465 *mls. of intermittent powered flight and* 185 *mls. continuous gliding); launching altitude,* 33,000 *ft.; service ceiling,* 75,000 *ft.; design absolute ceiling,* 83,000 *ft.; glide descent altitude,* 39,400 *ft.* **Weights:** *Empty equipped,* 3,620 *lb.; loaded,* 9,280 *lb.* **Dimensions:** *Span,* 57 *ft.* 7¼ *in., length,* 34 *ft.* 8½ *in.; wing area,* 323 *sq. ft.*

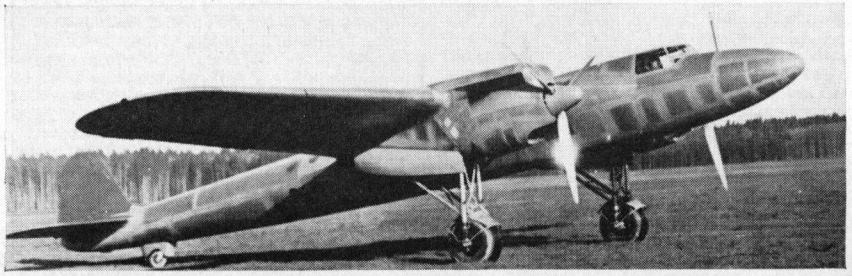
DORNIER DO 17 GERMANY

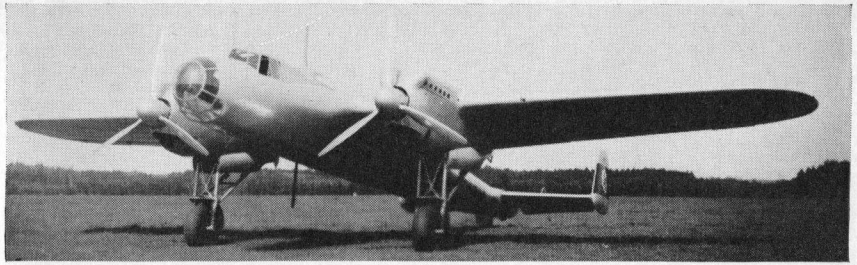
In the mid 'thirties the first rumours of the existence of a very fast and efficient *Schulterdecker-Kampfflugzeug* began to percolate through to the British and French air ministries from Germany; a graceful shoulder-wing bomber allegedly faster than any single-seat fighter extant. Confirmation of the existence of this advanced warplane came in October 1935 when one of the prototypes was demonstrated at Bückeberg, but it was not until nearly two years later, in July 1937, when the Do 17 V8 participated in the International Military Aircraft Competition at Zürich, winning the "Circuit of the Alps" and displaying a clean pair of heels to the fighters of every country represented in the contests, that it became generally known that this graceful aircraft had been developed. Indeed, so slim was the new bomber in side elevation that it was promptly dubbed the "Flying Pencil", and its showing at Zürich generated considerable publicity.

What was *not* known at Zürich was the fact that the Do 17 owed its existence as a bomber solely to chance. Nor was it known that the prototype that performed so spectacularly in Switzerland embodied aerodynamic improvements and substantially more powerful engines

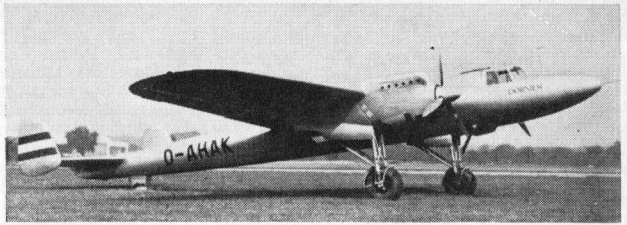


(*Left and below*) *The Do* 17 *V*1 *as originally flown in the autumn of* 1934. *The Do* 17 *V*1 *was a six-passenger commercial transport*





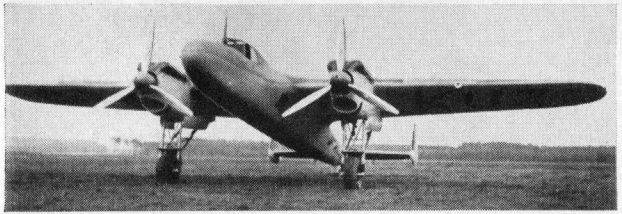
(*Above*) *The Do* 17 *V*9 (*D-AHAK*), *which first appeared in the spring of* 1936, *was the prototype for the initial production bomber, the Do* 17*E*–1. *Two years later it was adapted as a high-speed liaison and communications aircraft* (*right*)



than those of the production model then being delivered to the *Luftwaffe*, endowing the demonstration aircraft with a maximum speed that was 56 m.p.h. superior to that of the bomber entering service with the *Kampfgruppen*.

The Do 17 had been evolved at a time when the theories of air strategy prevalent in Germany relegated the fighter to a secondary role, the bomber possessing sufficient speed to elude interceptors. Although this was to prove a fallacy, the theory was reinforced by the début of the Do 17 which initiated the German trend towards relatively small, highly-loaded and high-powered but versatile aircraft which was to be maintained throughout World War II. Perhaps the most remarkable feature of the Do 17's development, however, was the fact that, unlike the He 111 which was designed from the outset as a bomber and first revealed as a commercial transport, the Dornier aircraft had been designed solely as a commercial transport!

Deutsche Lufthansa had conceived a requirement for a high-speed mailplane capable of carrying six passengers and suitable for use on European express services. To meet this requirement, Dornier evolved a design setting new standards in aerodynamic cleanliness which was to be powered by a pair of BMW VI 12-cylinder liquid-cooled engines which, each rated at 660 h.p. for take-off, were the most powerful aero engines then available in



The Do 17 V10 was employed primarily for engine development purposes, and was initially flown with increased compression ratio BMW V1 7.3 engines

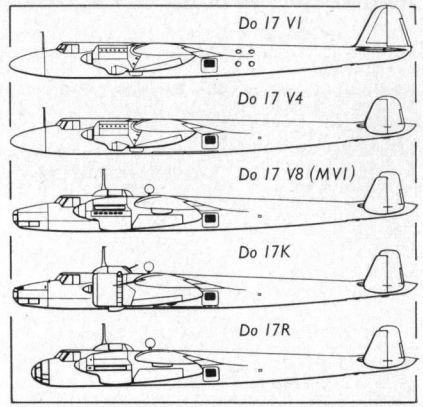
Germany. The most characteristic feature of the design was the exceptional slenderness of the fuselage side profile, this being accentuated by a long, pointed nose cone. The Do 17, as the design was designated, was by no means so slender in planform, however, the centre fuselage being, abnormally broad, the section commencing more or less as an oval, changing rapidly to what may best be described as an inverted triangle, about twice as wide at the top as at the bottom, and then reverting once more to an ellipse.

The fuselage structure comprised built-up frames and intermediate stiffeners with channel-section stringers, the whole being covered by light metal panels. The shoulder-mounted wing was of two-spar design with part metal and part fabric skinning. The spar booms were thick duralumin extrusions of unsymmetrical section, the primary ribs being built up of duralumin channel sections, and the intermediate ribs having tubular bracing. The fabric skinning was contained to the wing undersurfaces between the spars, slotted flaps extended between the ailerons and the fuselage, and all fuel was housed between the inboard section spars. The main undercarriage members retracted rearwards into the engine nacelles, and the tailwheel was also retractable.

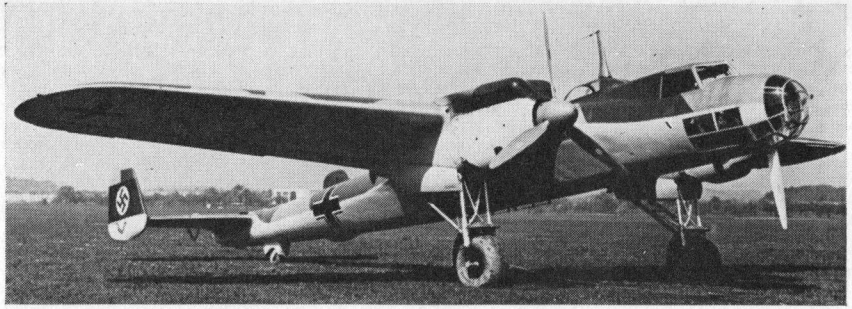
The first of three prototypes, the **Do 17 V1**, was completed and flown in the autumn of 1934, and before the end of the year the **Do 17 V2** and **V3** had joined the flight test programme, all three aircraft being passed to Lufthansa for evaluation early in 1935. Although the aircraft fully met the airline's performance demands, Lufthansa rapidly concluded that the Do 17 was unsuited for the services that it intended to operate as the passenger accommodation was impracticable. The Do 17's slim fuselage contained two tiny cabins; one compartment accommodating two passengers being situated immediately aft of the two-seat flight deck, and the other, seating four passengers, being positioned aft of the wing. Unfortunately, the passengers had virtually to perform acrobatics to enter these diminutive compartments, and extreme dexterity was called for if they were to gain their seats, and Lufthansa decided that such accommodation would have somewhat limited commercial appeal! The trio of prototypes was therefore returned to Dornier, and it is probable that the career of the Do 17 would have ended here had it not been for a casual visit to Dornier's Löwenthal plant by a former Dornier employee, *Flugkapitän* Untucht.

Untucht, who, after leaving Dornier, had joined Lufthansa to become that airline's star pilot and acted as liaison officer between the airline and the *Reichsluftfahrtministerium* (RLM), decided to fly one of the Do 17 prototypes himself. Impressed by the handling qualities and performance of the aircraft, Untucht suggested that, with some additional keel area to provide a stable bombing platform, the Do 17 could well be amenable to the bombing role. Although Dornier personnel were sceptical, the *Technische Amt* of the RLM proved receptive to Untucht's proposal, and after RLM test pilots had completed a preliminary flight evaluation of the aircraft, the company received instructions to produce a fourth prototype which was to embody the minimum modifications necessary for military trials. Thus, during the late summer of 1935, the **Do 17 V4** made its appearance, this prototype differing externally from its predecessor solely in having the cabin portholes eliminated and a twin fin-and-rudder assembly in place of the original single fin-and-rudder arrangement to eliminate the aircraft's tendency to yaw. Internal changes included provision of a radio-operator's compartment in the space previously occupied by the passenger cabin, and the introduction of a bomb-bay in the bottom of the fuselage behind the plane of the front spar. By comparison with the transport prototypes, the overall length of the Do 17 V4 was reduced from 58 ft. 1 in. to 56 ft. 3¼ in., but the BMW VI engines were retained.

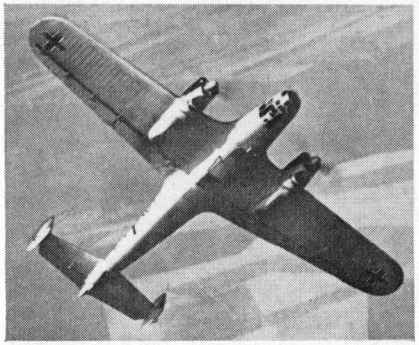
Two further prototypes, the **Do 17 V5** and **V6**, were built in parallel with the V4, these joining the flight test programme during the autumn of 1935. Whereas the V6 was virtually identical to the V4, the Do 17 V5 was powered by two Hispanso-Suiza 12Ybrs 12-cylinder liquid-cooled engines each rated at 775 h.p. at sea level and 860 h.p. at 13,120 ft., and with these power plants attained a maximum speed of 243 m.p.h. At this time, the Gloster Gauntlet fighter, which was just entering R.A.F. service, could barely reach 230 m.p.h., and no provision had been made for defensive armament in the Do 17, but wiser councils prevailed over the factions in the *Luftwaffe* that believed that speed alone would enable the bomber to evade interception, and a further prototype, the **Do 17 V7**, was completed with provision for a single aft-firing 7.9-mm. MG 15 machine gun mounted in a blister fairing above the forward fuselage and fired by the radio-operator. This prototype also featured a hemispherical glazed nose cap and flat glazed panels in the lower portion of the nose. The **Do 17 V8** was retained by Dornier as a development aircraft, and the **Do 17 V9**, which appeared in the spring of 1936, was to all intents and purposes, the prototype for the initial production bomber, the Do 17E-1.



The Do 17 V9, registered D-AHAK, differed from its predecessors in several respects. The fuselage nose was reduced in length by nearly three feet to 53 ft. 3¾ in.; the glazed nose cone was substantially enlarged and introduced



(Above) A Do 17E-1 bomber prior to delivery to the Luftwaffe early in 1938, and (below left) a Do 17F–1 long-range photo-reconnaissance aircraft



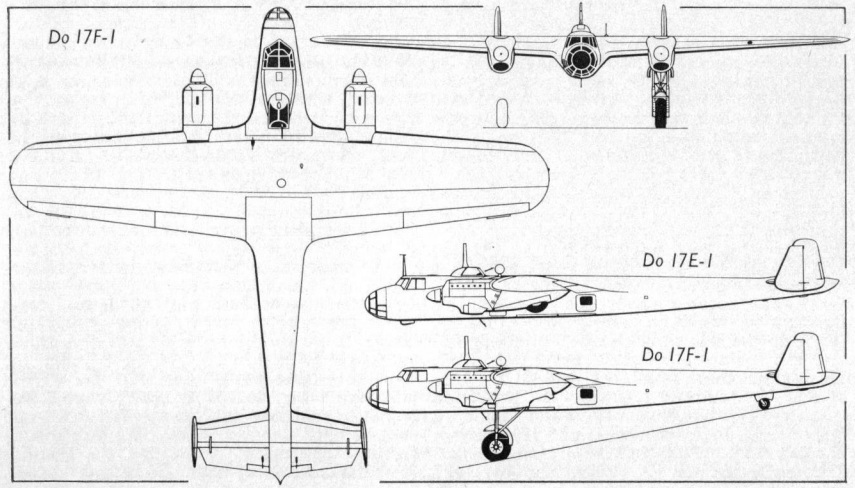
optically flat panels for the bombardier; additional glazed panels were inserted in the starboard side of the forward fuselage; the blister fairing aft of the flight deck was refined; the vertical tail surfaces were redesigned and enlarged, and full military equipment was installed. Two years later, the Do 17 V9 was to be adapted for the high-speed liaison and communications role in which it was to serve until 1944. The **Do 17 V10** (D-AKUZ) was completed for engine development purposes and, lacking the glazed nose and provision for defensive armament, was initially flown with the uprated BMW VI 7.3 in place of the BMW VI 6.0 engines of earlier prototypes. Featuring increased compression ratio, the BMW VI 7.3 offered a maximum output of 750 h.p. as compared with 660 h.p., but normal output remained 500 h.p.

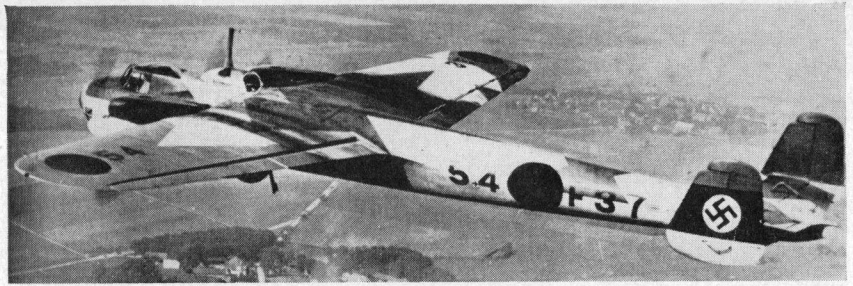
DORNIER DO 17E AND DO 17F

Preparations for the quantity manufacture of the Do 17 for the *Luftwaffe* had begun at Dornier's plants at Allmansweiler, Löwenthal and Manzell early in 1936, the initial production models being the **Do 17E-1** bomber and

the **Do 17F-1** long-range reconnaissance-bomber. Produced in parallel, the two models were essentially similar, the latter having the bomb sight and bomb-release mechanism removed, provision made for an auxiliary fuselage fuel tank, and a pair of automatic vertical cameras mounted in the bomb-bay. Both the Do 17E-1 and F-1 were powered by BMW VI 7.3 engines and carried a defensive armament of a 7.9-mm. MG 15 machine gun, although this was soon augmented by a second MG 15 mounted in the floor forward of the bomb-bay to fire downward through a hatch. The bomb-bay of the Do 17E-1 normally accommodated a 1,100-lb. load of horizontally-stowed bombs, typical loads comprising 10 110-lb. SC 50 bombs, four 220-lb. SD 100 bombs, or two 550-lb. SD 250 bombs, but for reduced-range missions the load could be increased to 1,650 lb.

Shortly after the *Technische Amt* of the RLM had begun to display interest in the potentialities of the Do 17 as a bomber, Dornier had initiated the "productionization" of the design, breaking a considerable proportion of the basic airframe down into component form readily amenable for sub-contract. This also had the advantage of enabling relatively major components to be replaced at unit level, and with the decision to adopt the Do 17 on a large scale the German aircraft industry's first major dispersed production programme was initiated,





A Do 17E-1 of 7.Staffel Kampfgeschwader 255. The III/KG 255 eventually converted to He 111s and became III/KG 51

this forming a pattern for programmes that were to follow, and before the end of 1936 the first production aircraft had left the assembly lines. Some difficulties were experienced with the first sub-contracted components, but production tempo built up rapidly, and by the beginning of 1937 a number of aircraft were undergoing service trials with the *Luftwaffe*.

During the early months of 1937, I/KG 153 at Merseburg and I/KG 155 at Giebelstadt, these being the *Luftwaffe*'s original *Kampffliegergruppen*, began conversion to the Do 17E-1 bomber, and, almost simultaneously, the first long-range reconnaissance *Gruppe*, Aufkl. Gr.(F)/122, began to receive the Do 17F-1, this unit (which was to be redesignated Aufkl.Gr. (F)/22 in the following October) attaining full strength with 36 aircraft by April 1937. During the course of 1937, II and III *Gruppen* of KG 153 followed I *Gruppe* and converted to the Do 17E-1 at Finsterwalde and Altenburg respectively, together with II and III *Gruppen* of KG 155. This last-mentioned *Kampfgeschwader* became KG 158 in October 1937 (KG 155 subsequently being reformed with He 111s), and in the same month, IV/KG 153 was activated on Do 17E-1s at Liegnitz as the eventual nucleus of KG 252, the *Gruppe* becoming II/KG 252 during 1938, I/KG 252 being formed at Cottbus in November of that year. A fourth *Kampfgeschwader*, KG 255, had begun forming on the Do 17E-1 before the end of 1937, and by that time plans had already been initiated to evaluate the *Luftwaffe*'s newest warplane under operational conditions in Spain.

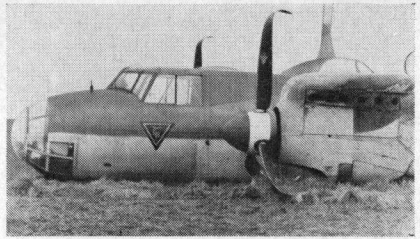
The importance placed by the High Command of the *Luftwaffe* on gaining actual operational experience may be gauged from the fact that, as early as the spring of 1937, one *Staffel* from Aufkl.Gr.(F)/122 was despatched to Spain with 15 Do 17F-1s, joining the Condor Legion as 1.A/88. The Do 17F-1s supplanted the He 70F-2s which were transferred to the Spanish Nationalist forces, and soon proved capable of evading Republican fighters, apparently vindicating the theories formulated by the High Command earlier.

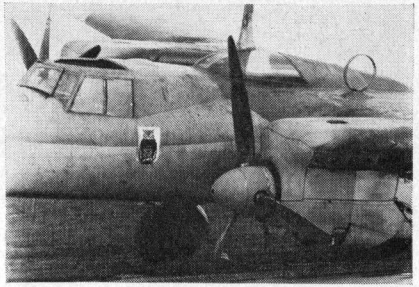
The virtual immunity to interception enjoyed by the Do 17F-1 in Spanish skies so impressed the *Luftwaffe* that high priority was allocated the re-equipment of all long-range reconnaissance units with this type, the He 70F quickly being retired from first-line service, and during the course of 1937-38, the Do 17F-1s of Aufkl.Gr.(F)/122 based at Prenzlau were progressively supplemented in *Luftwaffe* service as *Staffeln* of the other five existing *Aufklärungsgruppen* (Aufkl.Gr.(F)/121 at Neuhausen, /123 at Grossenhain, /124 at Kassel, /125 at Würzburg, and /127 at Goslar) converted to the Dornier.

In the meantime, the Do 17F-1 reconnaissance aircraft of 1.A/88 had been joined in Spain by Do 17E-1 bombers, 20 aircraft of this type supplementing the He 111B in 1. and 2.K/88. Like the Do 17F-1s, the bombers initially enjoyed virtual immunity to interception, but this was lost as increasing numbers of modern Soviet fighters made their appearance in Republican service, and in August 1938, the surviving Do 17E and F aircraft, together with a number of Do 17Ps (10 of which had earlier been delivered to 1.A/88 to supplement the unit's Do 17F-1s), were passed to the Spanish Nationalists, *Grupo* 8-G-27 being formed on these at La Cenia with both Spanish and German personnel. In Spanish service the Do 17s were known as *Bacalaos*, and when the Civil War terminated, 8-G-27 was based at Logroño with 13 Do 17Es and Do 17Ps, these remaining in Spanish service for a number of years.

DORNIER DO 17M AND DO 17P

Before the first production Do 17s had left the assembly line, the Dornier team had turned its attention to developing the basic design, and the **Do 17 V8**, which was also known as the **Do 17M V1** and which gave such a startling demonstration of its performance capabilities





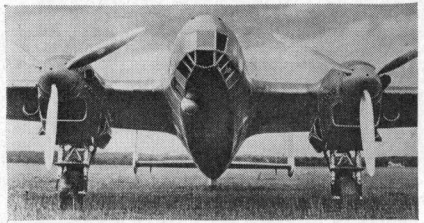
The Do 17E-1s in Luftdienst service (1940) above and below display an interesting variation in the cupola aft of the fight deck

in July 1937 at Zürich, was completed with Daimler-Benz DB 600A 12-cylinder liquid-cooled engines each rated at 1,000 h.p. for take-off and driving three-bladed VDM controllable-pitch airscrews. The Do 17M V1 (alias V8) attained a maximum level speed of 264 m.p.h. It was proposed that the DB 600A-powered Do 17M be placed in production for the *Luftwaffe*, but priority in the supply of the

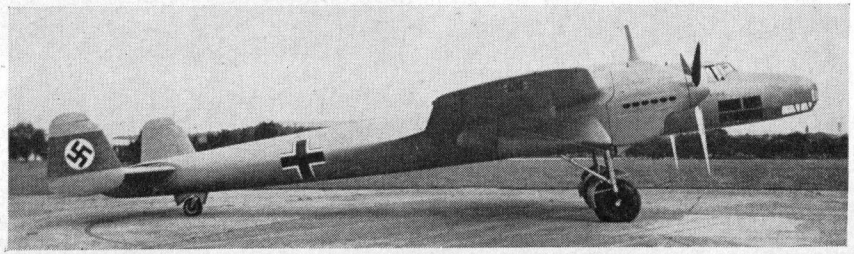
DORNIER DO 17E-1 SPECIFICATION
(Figures in parentheses relate to the Do 17F-1)

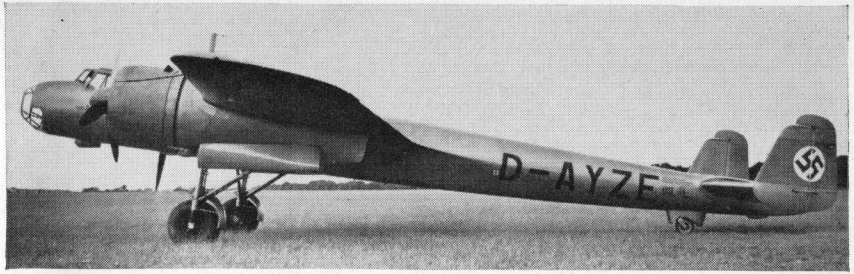
Type: *Three-seat Medium-Bomber (Long-range Reconnaissance Aircraft).* **Power Plants:** *Two BMW VI 7.3 12-cylinder liquid-cooled engines each rated at 750 h.p. for take-off.* **Armament:** *One 7.9-mm. MG 15 firing downward through ventral hatch, and one aft-firing 7.9-mm. MG 15 on pillar-type mounting at rear of flight deck. (Offensive) Maximum internal bomb load of 1,650 lb.* **Performance:** *Maximum speed, 220 (222) m.p.h. at sea level, 193 (196) m.p.h. at 13,120 ft.; maximum cruising speed, 196 (196) m.p.h. at sea level, 163 (165) m.p.h. at 13,120 ft.; tactical radius with maximum military load, 310 (422) mls.; maximum range without military load, 932 (1,275) mls.; service ceiling, 16,730 (19,685) ft.* **Weights:** *Empty, 9,920 lb.; loaded, 15,520 (15,430) lb.* **Dimensions:** *Span, 59 ft. 0⅜ in.; length, 53 ft. 3¾ in.; height, 14 ft. 2 in.; wing area, 592.014 sq. ft.*

Daimler-Benz engine was allocated to fighter production, and, in consequence, Dornier was forced to investigate the possibility of installing alternative engines. The choice eventually fell on the Bramo Fafnir 323A-1, a nine-cylinder radial air-cooled engine with two-speed supercharger offering 900 h.p. for take-off and 1,000 h.p. at 10,200 ft. The conversion from liquid-cooled to air-cooled engine presented no problem, the Do 17 taking both

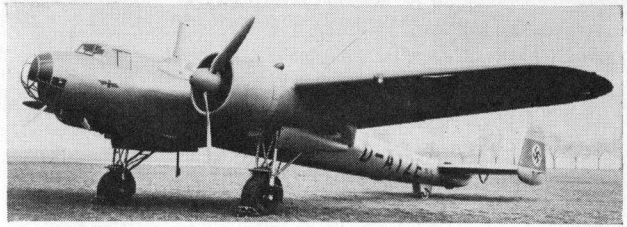


(Left and below) The Do 17M V1 which was demonstrated at Dübendorf, Switzerland, in 1937



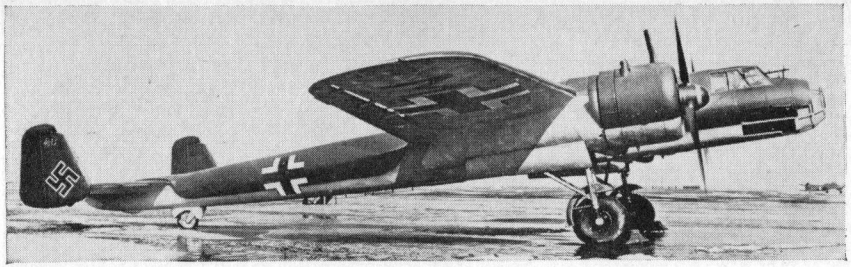


(Above and right) The Do 17M V2 (D-AYZE), alias V13, was one of two Bramo-powered prototypes for the Do 17M bomber



DORNIER DO 17M-1 SPECIFICATION
(Figures in parentheses relate to Do 17P-1)

Type: *Three-seat Medium Bomber (Long-range Reconnaissance Aircraft).* **Power Plants:** *Two Bramo Fafnir 323A-1 (BMW 132N) nine-cylinder radial air-cooled engines each rated at 900 (865) h.p. for take-off and 1,000 (665) h.p. at 10,200 (14,760) ft.* **Armament:** *One forward-firing 7.9-mm. MG 15 machine gun in starboard side of windscreen, one 7.9 mm. MG 15 firing downward through ventral hatch, and one aft-firing 7.9-mm. MG 15 on pillar-type mounting at rear of flight deck. (Offensive) Maximum internal bomb load, 2,205 lb.* **Performance:** *Maximum speed, 214 (217) m.p.h. at sea level, 255 (246) m.p.h. at 13,120 ft.; maximum cruising speed, 218 (206) m.p.h. at 10,670 (9,145) ft.; tactical radius with maximum military load, 310 (455) mls.; maximum range without military load, 845 (1,367) mls.; service ceiling, 22,965 (20,340) ft.* **Weights:** *Loaded, 17,640 (16,887) lb.* **Dimensions:** *Span, 59 ft. 0⅜ in.; length, 52 ft. 9¾ in.; height, 14 ft. 11 in.; wing area, 592.014 sq. ft.*

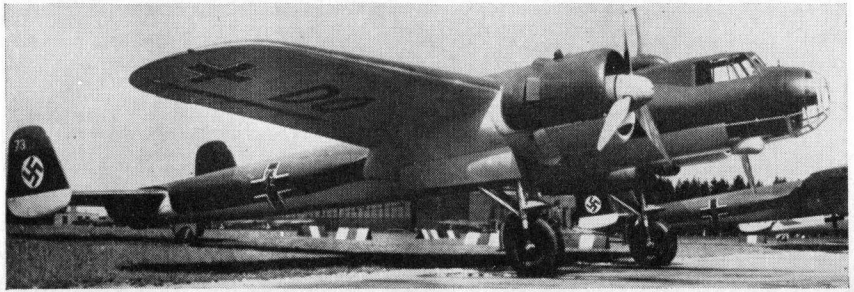


(*Above*) *A late production Do* 17*P–*1 *which received BMW* 132*N engines, and* (*below*) *a* 1938 *production Bramo-powered Do* 17*M–*1

types of power plant with equal facility, and thus, late in 1937, the assembly lines began to turn over from the Do 17E and F to the Do 17M and P.

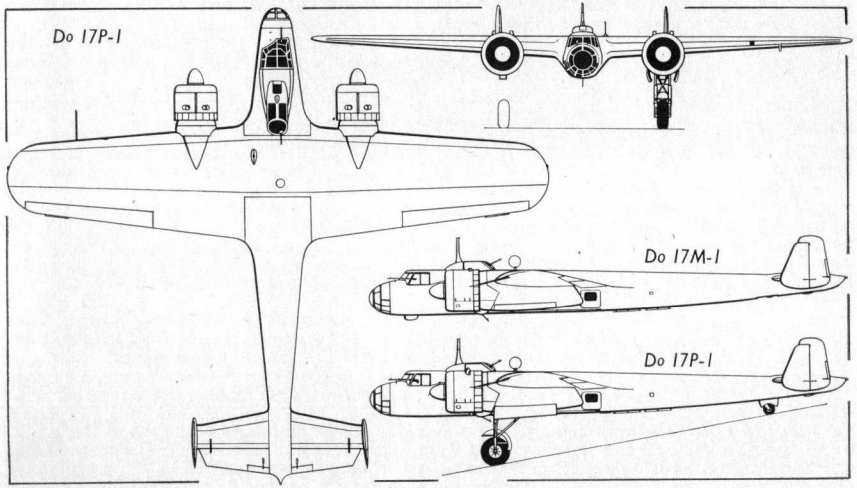
The Do 17M and Do 17P were parallel developments, being respectively bomber and long-range reconnaissance aircraft, but as it was not possible to meet the range demands of the *Luftwaffe* for the latter with the Bramo Fafnir 323A-1, Dornier elected to power the Do 17P with another nine-cylinder radial air-cooled engine, the less powerful but smaller, lighter, and rather more economical BMW 132N, which, rated at 865 h.p. for take-off and 665 h.p. at 14,760 ft., provided the aircraft with the depth of penetration specified.

Production of the new models was preceded by two Bramo-powered prototypes, the **Do**



17M V2 and **V3** (alias **Do 17 V13** and **V14**), and a BMW 132N-powered prototype, the **Do 17P V1** (alias **Do 17 V15**), and apart from some local structural strengthening to accommodate the increased power and higher loaded weights, the airframes of these variants remained virtually unchanged from those of their predecessors. A change was made in

A late-production Do 17*P-*1 *reconnaissance aircraft*



defensive armament which, initially at least, comprised a trio of MG 15s, a forward-firing weapon being added which, normally clamped in position and fired by the pilot with the aid of a ring-and-bead sight, could also be operated as a free gun by the navigator-bombardier, although its traverse was strictly limited. Do 17Ms and Do 17Ps surviving in *Luftwaffe* service after the first few months of World War II were to have a pair of additional MG 15s installed by forward maintenance units. The bomb-bay of the Do 17M was extended aft, enabling maximum bomb load to be raised to 2,205 lb., and towards the end of the production run, a housing was introduced ahead of the upper gun position for an inflatable dinghy, aircraft so fitted being designated **Do 17M-1/U1**. The provision of sand filters and desert survival equipment by forward maintenance units resulted in the **Do 17M-1/Trop** and **Do 17P-1/Trop**. Apart from power plants, the Do 17M and Do 17P differed solely in that the latter had bomb sight and release gear removed and provision made in the bomb-bay for a pair of RB 50/30 or 75/30 reconnaissance cameras.

In 1938, the Do 17M and Do 17P began to supplant the Do 17E and Do 17F in the *Kampfgruppen* and *Aufklärungsgruppen* respectively, and, as previously mentioned, 10 early production Do 17P-1 reconnaissance aircraft were sent to 1.A/88 with the Condor Legion in Spain, those surviving the Civil War subsequently serving with the *Ejercito del Aire*. According to OKL strength returns for September 19, 1938, the *Luftwaffe* had 479 Do 17s (E, F, M and P variants) on strength from a total 580 delivered at that time by Dornier, and production of an improved bomber model, the Do 17Z, had already been initiated. Thus, the production life of the Do 17M was relatively short and, in the event, this bomber was to be outlived in first-line *Luftwaffe* service by its long-range reconnaissance counterpart, the Do 17P.

EXPORT AND EXPERIMENTAL MODELS

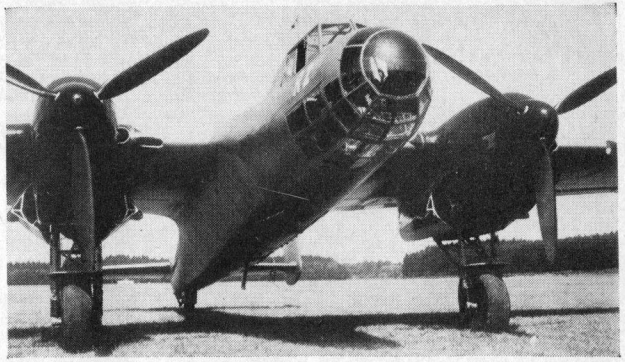
Manufactured in parallel with the Do 17M was an export version for Yugoslavia, the **Do 17K**. The Yugoslav delegation to the Zürich meeting in the summer of 1937 had been so impressed by the showing of the Do 17M V1, that the Yugoslav government had immediately approached Dornier with a view to acquiring this advanced warplane for the Royal Yugoslav Air Force. Official approval was immediately given the negotiations, and within two months a contract had been placed by the Yugoslav government for 20 aircraft, a manufacturing licence being purchased simultaneously.

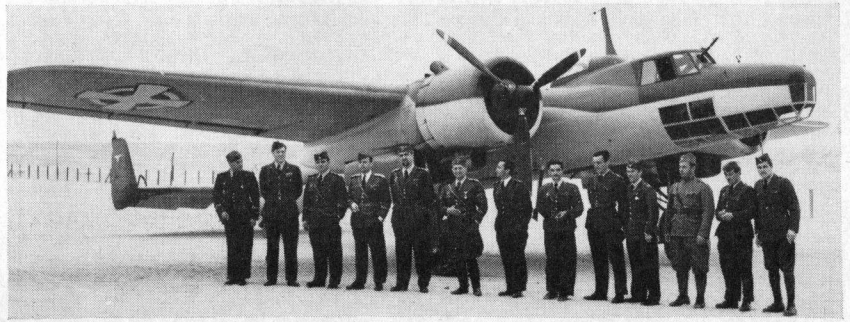
At that time, licence manufacture of the Gnôme-Rhône 14 N1/2 had begun at Rakovica, near Belgrade, and the Yugoslav-manufactured engines were supplied to Dornier for installation in the Do 17K, the first example of which was flown to Yugoslavia in October 1937. The export model did not feature the short nose with hemispherical glazed cap characteristic of the Do 17s supplied to the *Luftwaffe*, retaining the longer, more angular nose of the Do 17M V1, and the 20 aircraft delivered to Yugoslavia consisted of three versions, the **Do 17Kb-1** which was intended solely for the bombing role, and the **Do 17Ka-2** and **Ka-3** which, differing in camera arrangements and equipment, were primarily reconnaissance aircraft with secondary bombing and attack capability.

Powered by two Gnome-Rhone 14 N1/2 14-cylinder radials each rated at 980 h.p. at 14,850 ft., the Do 17K attained maximum speeds of 222 m.p.h. at sea level and 259 m.p.h. at 11,320 ft., and maximum range in the reconnaissance role was 1,490 miles. The maximum bomb load of the Do 17Kb-1 variant was

2,200 lb., and maximum defensive armament comprised one 20-mm. Hispano 404 cannon and one 7.92-mm. FN-Browning machine gun in the forward fuselage nose (although the cannon was not included in the armament of the Ka-3 version), one free-mounted machine gun in the starboard side of the cockpit, and a 7.92-mm. FN-Browning firing from a ventral trap ahead of the bomb-bay with a similar weapon firing aft from the upper position.

(Right) The Do 17R V2 (D-ATJU), an experimental variant wtih DB 601A engines. (Below) One of the two Yugoslav-built Do 17Kb-1 bombers that escaped to Heliopolis with cargoes of gold





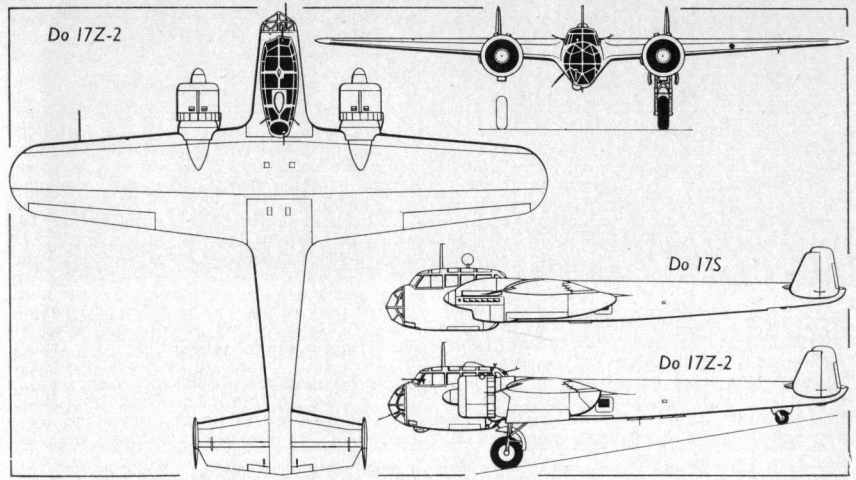
Production of the Do 17K started at the State Aircraft Factory, the *Državna Fabrika Aviona*, at Kraljevo in 1939, deliveries to the Royal Yugoslav Air Force commencing early in 1940, and when German forces invaded Yugoslavia on April 6, 1941, a total of 70 Do 17Ks was on strength, these equipping the 3rd Bomber Wing whose bases were prime targets for the *Luftwaffe* from the outset of the campaign. No fewer than 26 of the Do 17Ks were destroyed in the initial assault, but those that survived the *Luftwaffe*'s bombing and strafing made attacks on Sofia and other targets in Bulgaria, and were also used for strafing attacks on German armour and troop concentrations. Relatively few Do 17Ks survived, but on April 19th two escaped to Heliopolis with cargoes of gold (these being allocated the serial numbers AX706 and 707 but being struck off charge a few months after their arrival in Egypt), and those captured by the German forces were repaired and issued to the newly-formed Croatian Air Force early in 1942. Supplemented by a small number of Do 17E-1s passed to the Croat air arm by the *Luftwaffe*, the Do 17Ks equipped the Croatian *Gruppen* I and IV based at Agram and Banja Luka respectively, their activities being confined largely to sorties against partisan groups.

Evolved simultaneously with the Do 17M, the **Do 17L** was a similarly-powered (Bramo Fafnir 323A-1) pathfinder version with provision made for a fourth crew member. Two prototypes were completed, the **V11** and **V12** which were alternatively known as the **Do 17L V1** and **V2**, but no production was undertaken. Two further experimental aircraft were the **Do 17R V1** and **V2** which were essentially testbeds. Initially flown with BMW VI engines and subsequently re-engined with 950 h.p. Daimler-Benz DB 600Gs, the Do 17R V1 (D-AEEE) was employed principally as a testbed for new bomb-aiming devices but, like the Do 17R V2 (D-ATJU) which was powered by two 1,100 h.p. DB 601A engines, also served as a power plant development aircraft.

DORNIER DO 17Z

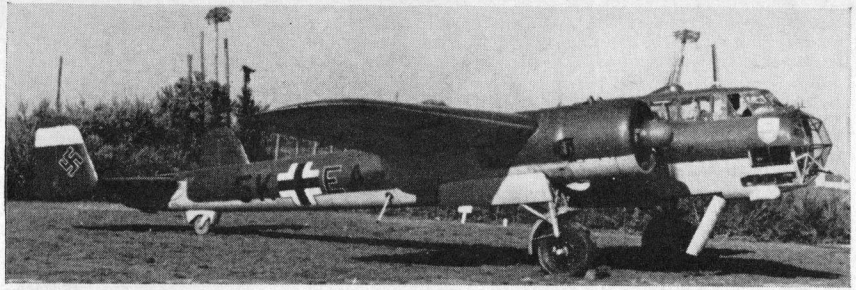
During the early months of 1939, the *Kampfgruppen* began to convert to a markedly improved development of the basic Dornier design, the Do 17Z, and this model was entering service when extensive redesignation and reorganisation of the *Kampfgeschwader* took place, three of the four existing Do 17-equipped *Geschwader* being reduced in strength from three to two *Gruppen*, and the fourth converting to He 111s, although an additional *Kampfgeschwader* was formed with Do 17s by transferring three *Gruppen* from existing units. Under this rearrangement II and III/KG 153 became II and III/KG 3, I and III/KG 158 became I and III/KG 76, I and II/KG 252 became I and II/KG 2, and I and III/KG 255 converted to He 111s and became I and III/KG 51. The *Gruppen* I/KG 153, II/KG 158 and II/KG 255 became respectively the I, II and III *Gruppe* of the newly-formed KG 77, and the first-line strength of the *Luftwaffe* thus comprised nine *Kampfgruppen* operating Do 17s of one or another version.

During the Spanish Civil War, it had become obvious that better protection would have to be afforded the Do 17's belly. The downward-firing MG 15 machine gun which was poked through a hatch in the floor had too limited a field of fire to provide anything approaching satisfactory protection, and thus the Dornier team had begun, early in 1938, to design an entirely new forward fuselage which owed everything to the dictates of operational efficiency and nothing to aerodynamic refinement. Crew accommodation provided by the Do 17 had always been somewhat cramped for maximum operational efficiency, and thus the cockpit roof was raised and fully glazed. The



nose containing the bombardier's station was also fully glazed with a series of small flat panels, or "facets", and the lower part was bulged and extended aft to a point just forward of the wing leading edge, terminating in a position for a rearward- and downward-firing MG 15.

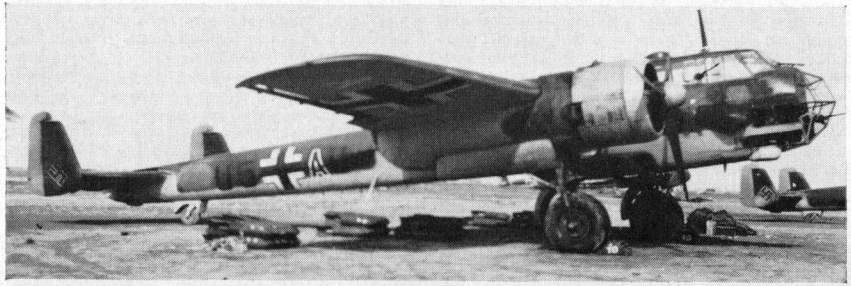
This new forward fuselage was first applied to a high-speed reconnaissance model, the **Do 17S-0** powered by two Daimler-Benz DB 600G engines and providing accommodation for four crew members. The first of three examples of the Do 17S-0 (D-AFFY) was flown early in 1938 and delivered to the *Luftwaffe* for service evaluation, but no further aircraft of this model were ordered. Evolved simultaneously with the Do 17S-0 was the **Do 17U** pathfinder which accommodated a crew of five, including two radio-operators, and was powered by Daimler-Benz DB 600A engines. Three pre-production **Do 17U-0** aircraft were followed by 12 production **Do 17U-1s**, and these were distributed among the *Kampfgruppen* designated to receive what was by this time considered to be the definitive Do 17 development, the Do 17Z which followed the Do 17U on the assembly line in the autumn of 1938. Two of the Do 17U pathfinders were delivered to 7 *Kompanie* of the *Luftnachrichten Abteilung* (Air Signals Department) 100, or Ln.Abt.100, this being absorbed by *Kampfgruppe* 100 in November 1939, the two



Do 17Us being retained on the *Gruppe Stab*.

The Do 17Z was essentially similar to the Do 17S and U, but owing to the uncertainty of supplies of the liquid-cooled Daimler-Benz engines which were in considerable demand for the fighter programme, switched to the Bramo Fafnir 323A-1 air-cooled radial. The pre-production **Do 17Z-0**, which appeared late in 1938, was a four-seat bomber. Armament remained three 7.9-mm. MG 15 machine guns —one on a pillar-type mounting in the rear of the flight deck, a second protruding through the starboard panels of the windscreen, and the third in a hemispherical mounting firing below the fuselage, but this was augmented by a fourth MG 15 protruding through the nose

(At head of page) A Do 17Z–2 (*5K-EA*) *of Stab/KG* 3, *and (below) a Do* 17Z–3 (*U5-AU*) *of* 10./*KG* 2. *KG* 2 *was the last Kampfgeschwader with the Do* 17Z

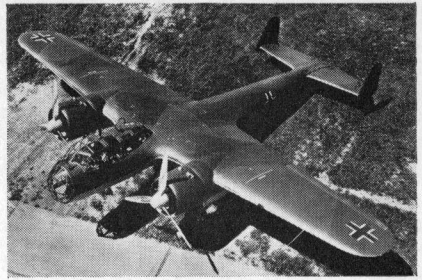


cone of the production Do 17Z-1 which had also made its appearance before the end of 1938.

The Do 17Z-1 possessed a similar airframe to that of the Do 17M-1, apart from the forward fuselage, and performance remained virtually unchanged despite the increased aerodynamic drag. It retained the good handling qualities and manoeuvrability of its predecessor, but with the additional crew member and increased armament and equipment, the Do 17Z-1 was decidedly underpowered with the full 2,205-lb. maximum bomb load. Accordingly, bomb load was reduced to 1,100 lb., but was restored to 2,205 lb. early in 1939 with the appearance of the **Do 17Z-2** fitted with Bramo Fafnir 323P engines with two-speed superchargers and developing 1,000 h.p. for take-off and 940 h.p. at 13,120 ft. The restoration of the full bomb load necessitated some reduction in fuel capacity, however, and depth of penetration in maximum loaded condition was reduced to only 205 miles. The Do 17Z-2 could accommodate an additional crew member for certain missions, and produced in small numbers was a reconnaissance-bomber variant, the **Do 17Z-3,** which carried automatic RB 20/30 cameras in the entry hatch and a 1,100-lb. bomb load.

Modifications carried out by *Luftwaffe* maintenance units resulted in the **Do 17Z-4** dual-control trainer, and the **Do 17Z-5** fitted with inflatable flotation bags and additional life-saving equipment to suit it for long-range over-water reconnaissance missions.

The Do 17Z was popular with both flying and ground personnel, and was the most reliable of the *Luftwaffe*'s bombers, but it lacked the load-carrying capability of the He 111 and the speed of the Ju 88, and by the end of 1939 production was already tapering off, finally terminating during the early summer of 1940, by which time some 500 Do 17Z-1 and



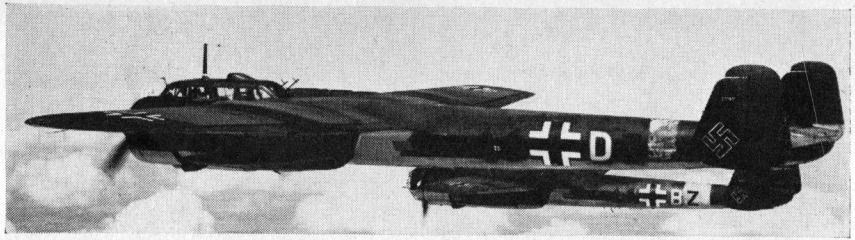
An early production Do 17Z-1, *deliveries of which began to the Luftwaffe early in* 1939

-2 bombers and 22 Do 17Z-3 reconnaissance-bombers had been delivered.

OPERATIONAL CAREER

On September 2, 1939, the nine *Kampfgruppen* (KG 2, 3, 76 and 77) of the *Luftwaffe* equipped with Do 17s possessed a first-line strength of 370 aircraft of which 319 were serviceable. Of these, 212 were Do 17Z-1s and -2s (of which 188 were serviceable), the remainder being Do 17M-1s plus a small number of Do 17E-1s awaiting imminent replacement. There were 23 long-range reconnaissance *Staffeln* with a total strength of 262 Do 17s (of which 235 were serviceable), all but one *Staffel* being equipped with the Do 17P-1, the remaining *Staffel* having Do 17F-1s. In addition, the *Stab* of each of the nine Ju 87-equipped *Stuka-Gruppen* had three Do 17M-1s on strength, as did also the *Geschwaderstab* of the otherwise He 111-equipped KG 51.

The Do 17-equipped *Aufklärungsstaffeln* were distributed among the four *Luftflotten*; nine



Do 17Zs of the second Croatian Volunteer Formation (A1-DZ and A1-BZ) of 15./KG 53

Staffeln—3.(F)/10, 2, 3, and 4.(F)/11, 1.(F)/120, and 1, 2, 3, and 4.(F)/121—being attached to *Luftflotte* 1 in N. E. Germany; three *Staffeln*—1, 2, and 3. (F)/122—being attached to *Luftflotte* 2 in N. W. Germany; six *Staffeln*—1, 2 and 3.(F)/22 and 1, 2 and 3.(F)/123—being attached to *Luftflotte* 3 in S. Germany, and three *Staffeln*—4.(F)/14, 3.(F)/31 and 1.(F)/124—being attached to *Luftflotte* 4 in Austria, Silesia and Czechoslovakia. Two other Do 17 *Aufklärungsstaffeln*—7 and 8.(F)/LG 2—were on the strength of *Luftwaffe Lehr Geschwader* 2.

The first Do 17 operational sortie of World War II was undertaken by a *Staffel* of Do 17Z-2s from III/KG 3 which took-off from Heiligenbeil in East Prussia at 05.30 hours, 45 minutes after the official outbreak of war, to bomb the approaches to the important railway bridge at Dirschau, a major link across the Polish Corridor, but for the most part all four Do 17 *Kampfgeschwader* (KG 2 and 3 in the North and KG 76 and 77 in the South) concentrating primarily on attacking Polish airfields, ammunition dumps, troop concentrations, and targets of opportunity throughout the Polish campaign.

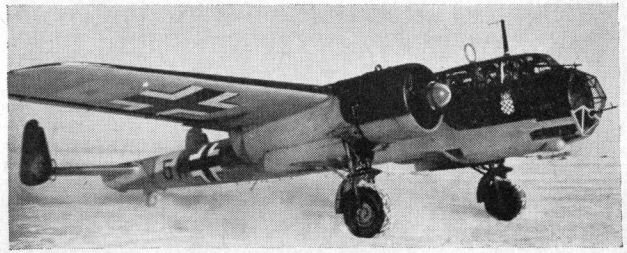
The Do 17 *Kampfgeschwader* did not participate in the Norwegian campaign in April 1940, but all had been transferred to the West to participate in the fighting over France, their efforts culminating on May 27th in attacks by the Do 17Zs of KG 2 and 3 on Dunkirk. The "Battle of Britain" opened with attacks on Channel convoys early in July 1940, and the *Kommodore* of KG 2, *Oberst* Fink, was given the title of *Kanalkampfführer*, or Channel Battle Leader, and entrusted with the task of clearing the Channel with a battle group comprising the Do 17Zs of his own KG 2, plus two *Stuka-Gruppen* and one *Zerstörergeschwader*, the first attack being made on a convoy off Dover on July 10th. On *Adlertag*, August 13th, the Do 17Zs of KG 2 bombed Eastchurch as the sole *Kampfgeschwader* which did not receive Goering's postponement order, losing four Do 17Zs in the process. Two days later, Do 17Zs of KG 3 bombed Eastchurch and Rochester, and on the 16th the Dorniers of KG 76 attacked West Malling, following this with attacks on Kenley and Biggin Hill on the 18th.

Apart from its good manoeuvrability the Do 17Z was able to undertake shallow diving

attacks at speeds exceeding 370 m.p.h., thanks to its high structural strength, and was thus the most successful of German bombers employed during the "Battle of Britain" in evading R.A.F. fighters. Despite the fact that it carried no armour protection for its crew members, the Do 17Z proved capable of absorbing a considerable amount of punishment, but whereas it had encountered virtually no fighter opposition over Poland, its incursions over Britain soon revealed the fact that its defensive armament was lamentably weak, and in consequence, forward maintenance units added two 7.9-mm. MG 15s which could be fired laterally from the radio-operator's position. Soon afterwards these were supplemented by yet another pair of MG 15s to provide a total defensive armament of eight machine guns. In their operations against Britain, the Do 17Z formations specialized in low-level, terrain-following attacks, making maximum use of the element of surprise, but their numerical importance in the *Luftwaffe*'s first-line operational strength was already dwindling.

The II *Gruppe* of KG 76 had been formed from the outset on the Ju 88A, and by the end of 1940, I and III *Gruppen* had converted from the Do 17Z to the Junkers type. Before the commencement of the "Battle of Britain", KG 77 had been withdrawn from operations to exchange its Do 17Zs for Ju 88As, and KG 3, after participating in concert with KG 2 in some of the first night attacks mounted against London in September 1940, began to exchange its Do 17Zs for Ju 88As, although III/KG 3 retained the Dornier bombers. Thus, when the assault on the Soviet Union began on June 22, 1941, KG 2 was the sole remaining *Kampfgeschwader* fully equipped with the Do 17Z, and even II and III/KG 2 were on the verge of conversion to the Do 217E.

During the spring of 1941, the Do 17Zs of KG 2 had been transferred South-East to participate in the offensive against Greece and the Balkan countries under *Luftflotte* 4, and by the end of May was based at Tatoi in Greece for anti-shipping sorties in the Eastern Mediterranean. In the following month, the Do 17Zs of I and III/KG 2, together with those of III/KG 3 began operations on the Eastern Front, II/KG 2 remaining in the West to complete conversion to the Do 217E, to which type the other two *Gruppen* of the *Geschwader* converted progressively during the remaining months of 1941. Thus, apart from III/KG 3, the Do 17Z disappeared from the



A Do 17Z-2 of 10. (Croat)/KG 3 on the Russian Front, operating rom Vitebsk in the winter of 1941–42

Luftwaffe's first-line bomber strength.

This last Do 17Z-equipped *Gruppe* operated on the Central Sector of the Russian Front where it was joined in October 1941 by a *Staffel* of the Croatian Air Force which had undergone conversion training on the Do 17Z at Greifswald. The Croat contingent began operations from Vitebsk shortly before Christmas, and as III/KG 3 returned to Germany for conversion to the Ju 88, their Do 17Zs were passed to the Croats who, by the beginning of 1942, were operating as IV/KG 3, although the unit was at hardly more than *Staffel* strength. After losing six crews on operations, this unit was withdrawn to Croatia, returning to the Russian Front, still with Do 17Zs, in July 1942, by which time the unit had been redesignated 15. (Croat)/KG 53. The Croat *Staffel* finally left the Russian Front in November 1942, subsequently being confined to anti-partisan operations in Croatia.

Early in 1942, Goering made a gift of 15 ex-*Luftwaffe* Do 17Z-2s to the Finnish Air Force, and these, supplanting the Blenheims of PLeLv 46, joined operations in April 1942, subsequently undertaking both day and night sorties with considerable success. By the time the Russian offensive began in June 1944, only five serviceable and four unserviceable Do 17Zs remained on PLeLv 46's strength.

With the final withdrawal of the Do 17 from the *Luftwaffe*'s bombing elements, the Dornier emerged in a new role—that of glider-tug. At the beginning of 1943, the Do 17 was serving as a tug for DFS 230 gliders with I *Gruppe* of *Luftlandegeschwader* 1 (Air-Landing Group 1) which participated in the supply, and later evacuation, of the German 17th Army fighting in the Kuban bridgehead. These operations lasted from February until October 1943, after which came the evacuation of the Crimea, and by March 1944 the unit had converted to the He 111/Go 242 combination. The Do 17 continued to soldier on in the glider-tug role until the last days of the war in Europe, however, serving with the *Schleppgruppen*, one of its last operations being the aerial supply of Budapest early in 1945.

DORNIER DO 17Z-2 SPECIFICATION

Type: *Four-seat Medium Bomber.* **Power Plants:** *Two Bramo Fafnir 323P nine-cylinder radial air-cooled engines each rated at* 1,000 *h.p. for take-off and* 940 *h.p. at* 13,120 *ft.* **Armament:** (*Defensive*) *Two fixed of free-mounted* 7.9-*mm. MG* 15 *machine, two* 7.9-*mm. MG* 15 *machine guns firing from side windows, and two* 7.9-*mm. MG* 15 *machine guns firing aft, one above and one below the fuselage.* (*Offensive*) *Maximum internal bomb load of* 2,205 *lb., typical loads including* 20 110-*lb. SD* 50 *or four* 551-*lb. SD* 250 *bombs.* **Performance:** (*At maximum loaded weight*) *Maximum speed,* 186 *m.p.h. at sea level,* 224 *m.p.h. at* 13,120 *ft., (at* 17,730 *lb.)* 214 *m.p.h. at sea level,* 255 *m.p.h. at* 13,120 *ft.; cruising speed (at maximum loaded weight),* 168 *m.p.h. at sea level,* 186 *m.p.h. at* 13,120 *ft.; tactical radius with standard fuel (two* 170.5 *Imp. gal. wing tanks) and* 2,205-*lb. bomb load,* 205 *mls.; maximum range with auxiliary fuselage tank* (197 *Imp. gal.) and* 1,100-*lb. bomb load,* 720 *mls.; service ceiling,* 22,965 *ft. at* 18,832 *lb.,* 26,900 *ft. at* 17,730 *lb.* **Weights:** *Empty,* 11,484 *lb.; empty equipped* 12,958-13, 145 *lb.; maximum loaded,* 18,931 *lb.;* **Dimensions:** *Span,* 59 *ft.* 0⅛ *in.; length* 51 *ft.* 9⅞ *in.; height,* 14 *ft.* 11½ *in.; wing area,* 592.014 *sq. ft.*

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